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ABSTRACT

This research seeks to develop a theory of children's achievement motivation and to move research in the direction of greater educational application. Five studies demonstrate that: (1) high anxious children function very poorly on basic arithmetic skills in conditions involving time pressure and some failure but do almost as well as low anxious children when time pressure and failure are removed; (2) interfering effects of anxiety on performance at achievement test items can be reversed in testing conditions maintaining time limits and involving failure if children's criteria and expectancies for success are modified; (3) anxious children spend a good deal of their time off-task in a verbal learning situation, with such off-task behavior directly related to poor performance at the task; (4) high anxious children will avoid taking risks on a design completion task and children in general will take less risk if later evaluation from an adult is expected; and (5) both high and low anxious children can process the information communicated by nonreaction from an adult in an evaluative situation if the adult is evaluating another child. Research indicates that motivational factors are important determinants of learning and performance. (Author)

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FINAL REPORT

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## Summary Page

A program of research was carried out to develop a theory of children's achievement motivation and to move research in the direction of greater educational application. The theoretical model (see Hill, 1972) emphasizes children's motives to approach success and approval and to avoid failure and disapproval, their attributions for success and failure, and social aspects of evaluation. Five studies were carried out, many involving the actual achievement behaviors learned in school and testing conditions directly related to classroom learning or ability/achievement testing procedures.

Two studies involved optimizing testing conditions seeking to establish the factors determining high anxious children's poor performance in traditional learning and testing situations and to demonstrate that motivational rather than cognitive/learning deficiencies are responsible for such poor performance. One study demonstrated that high anxious children function very poorly on basic arithmetic skills in conditions involving time pressure and some failure but do almost as well as low anxious children when time pressure and failure are removed. This theoretical study demonstrates that high anxious children have greater ability than they show under highly evaluative testing conditions. A second study found that the interfering effects of anxiety on performance at achievement test items can be reversed in testing conditions maintaining time limits and involving failure if children's criteria and expectancies for success are modified. The two studies show the importance of the motives to avoid failure and disapproval as controlling factors in the inferior performance of high anxious children in school learning and testing situations.

Three additional studies helped clarify the processes mediating the effects of evaluation anxiety in problem solving situations. One study demonstrated that anxious children spend a good deal of their time off task in a verbal learning situation, with such off-task behavior directly related to poor performance at the task. Another study indicated that high anxious children will avoid taking risks on a design completion task and children in general will take less risk if later evaluation from an adult is expected. A final study showed that both high and low anxious children can process the information communicated by nonreaction from an adult in an evaluative situation if the adult is evaluating another child, so that the observing child is not performing at the task and does not have to worry about failure or disapproval.

The research indicates that motivational factors such as test anxiety are important determinants of elementary school children's school learning as well as their performance on tests of ability and achievement. The research suggests ways to change classroom teaching and student assessment activities and formal testing procedures to provide a more accurate assessment of and facilitate skill acquisition and achievement of anxious children. Further study of optimizing testing conditions was concluded to be an especially promising direction for future research to further develop both theories of achievement related motives and classroom testing applications of the work.

## Body of Final Report

### 1. Introduction: Problem and Objectives

A major purpose of the present research is to develop a comprehensive theory accounting for the development of evaluation anxiety and achievement motivation and the effects of these motivational variables on learning and achievement behavior in elementary school children. The model (see Hill, 1972) seeks to integrate and build on the work of Atkinson, the Crandalls, Sarason, Veroff, and others. Emphasis is placed on children's motives to approach success and approval and motives to avoid failure and disapproval, their problem solving strategies and attributions of their successes and failures, and their reactions to social aspects of evaluation. The research seeks to integrate within a unified theoretical framework effects of evaluative adult reactions and success-failure experiences previously studied in separate literatures, e.g. test anxiety, achievement motivation, and social reinforcement. The research is directed at demonstrating that motivational and personality factors are an important determinant of many children's learning and school progress, as well as their performance on achievement and ability tests.

A second major goal of the present research, in addition to developing a theory of children's achievement-related motives, is to move research in the direction of greater educational application. This is done in three ways. First, many of the studies carried out used dependent measures involving the actual behaviors children are learning in school. Measures used included arithmetic addition problems, computation and word problems taken directly from arithmetic subtests of standardized achievement tests, and other verbal tasks. Second, many of the experimental conditions and situations used in the research were directly related to either classroom learning situations or standard achievement test conditions. Third, a combined experimental/correlational approach was used in the research. Most of the studies carried out included both (1) groups of children determined by self-report measures of test anxiety and defensiveness (individual difference variables presumed to measure and reflect long-term social evaluation and success-failure experiences in school), and (2) experimental manipulations of factors believed causal to the effects of approval/disapproval and success/failure. Each of these attributes of the research make it more likely that findings have direct implications for classroom teaching or educational testing.

Specific objectives and hypotheses tested for the five studies carried out in the project are discussed after the general review of the literature and at appropriate points in the review of the purpose, method, results, and conclusions for each study.

### 2. Review of Literature

Considerable research on test anxiety in children has been stimulated by a large scale investigation initiated over fifteen years ago at Yale University (Sarason, Davidson, Lighthall, Waite, & Ruebush, 1960). Sarason and

his associates view test anxiety as a relatively stable personality characteristic that originates in parent-child interactions during the preschool years. They constructed their theory within a psychoanalytic framework (Sarason et al., 1960, Chapter 2). The reactions of children who are anxious in test and test-like situations in school are presumed to reflect evaluation experiences in the home both before and after the beginning of formal schooling. The anxiety process is thought to begin in early parent-child interactions at a point when there is a disparity between the child's performance and the higher standards for performance and achievement which his parents set for him. The child's failure to live up to his parents' standards and the parents' ensuing negative judgments of the child's adequacy are believed to lead to a series of internal reactions, beginning with hostility toward the rejecting parents. These hostile feelings lead, in turn, to guilt which results in self-derogation and repression of the hostile feelings.

According to this theory, the child's initial hostility toward the over-demanding parents also leads to unconscious fantasies of retaliation and rejection by the parents. Such fantasies are viewed as a threat to the fulfillment of the child's dependency needs and lead to both repression of the hostile feelings and initiation of behaviors directed at pleasing the parents. The child may seek approval, direction, and support from his parents and may lose his creativity and independent functioning in problem solving situations in his efforts to avoid negative parental evaluations. The Sarason theory, then, places emphasis on the high test anxious child's strong dependency needs and strong fear of failure (Hill & Sarason, 1966).

It should be noted that empirical evidence gathered in support of the Sarason model has been stronger with regard to the hypothesized initial parent-child interactions (e.g. Ruebush, Byrum, & Farnham, 1963) and the intellectual and learning deficiencies hypothesized to be a result of the "defenses" the high test anxious child develops to cope with his anxiety, e.g. a cautious problem solving strategy (see Ruebush, 1963; Hill & Sarason, 1966; Hill, 1972). Research has been less convincing with regard to the internal reactions involving hostility, guilt, and the like.

A second conception of anxiety and achievement behaviors can be found in the theory of achievement motivation developed by Atkinson (1964) and summarized by Atkinson and Raynor (1974). Here, test anxiety is equated with the motive to avoid failure, and achievement motivation is equated with the motive to approach success. According to this position, individuals who are more strongly motivated to achieve success than they are to avoid failure show preference for tasks of intermediate difficulty, persistence in working at achievement related tasks, and a higher level of performance at achievement tasks (Atkinson & Feather, 1966). Thus, the less anxious individual (and especially the high achievement motivated person) seems to prefer conditions of problematical success and accomplishment. The test anxious person, in contrast, will seek to avoid failure when given the opportunity by choosing either very easy tasks in which success is assured or very difficult tasks in which unsuccessful performance would be expected, avoiding achievement situations in general,

quitting in the face of failure, and performing with relatively little vigor (see Weiner, Frieze, Kukla, Reed, Rest & Rosenbaum, 1971). This theory, then, places strong emphasis on the motives to approach success and avoid failure. It should be noted, however, that attention has also been given to the role of social approval and evaluation as determinants of achievement behaviors (see Atkinson & O'Connor, 1966).

Predictions from the Atkinson theory have received greater support in extensive research with adults for choice and persistence than for performance measures (Atkinson & Feather, 1966; Maehr & Sjogren, 1971). Although test anxiety and achievement motivation have also been related to risk taking in children (Kogan & Wallach, 1964; McClelland, 1958), there has been little research directly testing the Atkinson theory with children. Perhaps the most important difficulty has been that the projective tests used to measure the achievement motive in adults have problems in their own right (see Atkinson & Feather, 1966) and have not been successfully modified for use with younger subjects.

The theory we are developing (Hill, 1972) combines elements of both the Sarason and Atkinson formulations but with additional emphases and assumptions. Here too, it is assumed that evaluation anxiety begins in the preschool years in response to unrealistically high parental standards and critical reactions. We would suggest that such parental behaviors cause children to develop the motivational dispositions to approach (obtain) praise and avoid criticism as presented in Figure 1 (see Appendice 2). The exact heights of the bars in this theoretical graph are arbitrary; rather, the graph is intended to depict two general effects. First, it is suggested that with increasing anxiety, children become generally more responsive to evaluative reactions from adults. (This hypothesis is consistent with Sarason's notion about dependency needs.) Presumably, the frequent critical reactions of anxious children's parents cause these children to be concerned about both positive and negative adult evaluation. Second, we would suggest that with increasing anxiety the motive to avoid criticism replaces the motive to obtain praise as the primary determinant of behavior. (This hypothesis is consistent with the general psychological principle that punishment or other aversive stimulation operates more strongly than reward or other positive stimulation.) Thus, low anxious children may show a stronger motive to obtain praise than to avoid criticism whereas anxious children show the opposite tendency; they are primarily motivated to avoid criticism. It is also suggested that as children become older, the primary locus of evaluative feedback shifts from the parents to teachers and eventually to peers, similar to age changes in other forms of social pressure (see Bronfenbrenner, 1970).

The motivational gradients suggested in Figure 1 are similar in general nature to those represented in Atkinson's theory--they suggest the strength of the child's disposition to bring about or maintain environmental events with positive incentive value (here, praise), and to avoid or terminate events with negative incentive value (here, criticism). We would expect, for example, that anxious children would orient more toward evaluation from an adult experimenter, whereas less anxious children would attend more to

their performance outcomes in problem solving tasks. Less anxious children should also orient to their own internal evaluations of their performance, as is true of older children in general (Crandall, 1967). Further, low anxious children should be more likely than anxious children to respond to the informational (non-social) component of an adult's reactions rather than to the accompanying social cues or social context in which the reactions are made. The former reactions again are more typical of older children (Allen, 1966; Crandall, 1967; Hill, 1975).

The motives for positive and negative adult reactions of concern should lead to two general sets of behaviors. First, in non-evaluative, non-achievement areas, the anxious child's stronger motive to avoid criticism leads to obedience to parental wishes and rules and to the passive, unaggressive personality cluster originally suggested by Sarason. On the other hand, the less anxious child develops greater autonomy from parental reactions and a more assertive personality. Second, in intellectual and achievement situations which involve standards of performance evaluation, the motives depicted in Figure 1 may lead, respectively, to the motives to approach success and to avoid failure presented in Figure 2 (see Appendice 2). It is assumed that success often results in praise and failure often results in criticism in the home and school situation. Thus, the anxious child's strong motive to avoid failure is seen as being based on his strong motive to avoid criticism, since criticism frequently accompanies failure. Veroff (1969) has also suggested that the primary concern of a person with strong fear of failure is to avoid disapproval, especially if based on unfavorable comparisons between the individual and others. Similarly, Crandall (1967) has emphasized that achievement behaviors are directed toward attainment of approval or avoidance of disapproval for competence of performance. Consistent with the Sarason and Atkinson formulations, we would suggest that the high anxious child has a stronger motive to avoid failure than to approach success. Low anxious children, in contrast, are seen as having a relatively stronger motive to succeed than to avoid failure, which Atkinson defines as achievement motivation. It is also suggested here that both motives are stronger in high anxious than in low anxious children so that, for example, anxious children would both persist longer under continued success as well as leave sooner under continued failure compared to less anxious children, and similar to younger children in general (Allen, 1966).

## 3. Procedures

### Study 1. Test Anxiety and Success/Failure as Determinants of Performance

The major purpose of what will be referred to as Study 1 was to separate out the effects of success and failure motives operating together from the effects of the success motive per se. A full length journal-style paper reports the rationale, method, findings, and conclusions for this study in detail in Appendice 4 under the authorship, Hill & Eaton, 1975. Briefly, it was predicted from the Hill (1972) model that in a condition involving both success and failure, high anxious children would, compared to less anxious children, make more errors, take more time, spend more time off task, persist less, and show more cheating behavior at an arithmetic addition task

typical of those learned in elementary school. In contrast, in a condition involving success only, in which the motive to approach success should predominate and the motive to avoid failure should operate minimally if at all, it was expected that high anxious children would show marked improvement in performance, e.g. to go much faster and make fewer errors. It was seen as an empirical question as to whether high anxious children would catch up to or possibly even surpass the performance of low anxious children in the success only condition.

The subjects for Study 1 included 60 fifth- and sixth-grade children from a large sample of 71 children for whom scores from the Test Anxiety Scale for Children (TASC, see Appendice 3) and LIE Scale for Children (LSC, see Appendice 3). After excluding highly defensive children with high LSC scores (whose report of anxiety is of doubtful validity), children were grouped into low, middle, and high test anxious groups.

An equal number of boys and girls at each of the three anxiety levels were randomly assigned to one of two experimental conditions while they performed at arithmetic addition problems either (1) to a mixed success/failure condition in which they were allowed to complete two-thirds of the problems they attempted but were unable to complete one-third of the problems due to time limits imposed by a signal bell, or (2) to a success only condition in which children were allowed to complete all of the problems they attempted. Measures of performance included rate, time off-task, errors, cheating, and persistence (number of problems attempted).

Study 2. Test Anxiety, Optimizing Instructions, and Arithmetic Test Performance

Study 2 examined the performance of low, middle, and high anxious children on age-norm appropriate arithmetic problems under test conditions and under time pressure. A full length journal style paper reporting the rationale, method, findings, and conclusions for Study 2 in detail is presented in Appendice 5 under the authorship, Williams & Hill, 1975. Briefly, the major purpose of Study 2 was to test for facilitating effects of different kinds of optimizing instructions on high test anxious children's performance on problems taken from achievement tests currently used in the schools. The conditions were designed to minimize the child's anticipation of failure or disapproval from the adult or to eliminate entirely expected evaluation. The study sought to demonstrate that anxious children have greater ability and achievement mastery than they show under standard achievement test conditions.

The subjects for Study 2 included 144 fourth- and fifth-grade boys and girls from two elementary schools from a sample of 151 children for whom TASC and LSC scores were available. Seven children were eliminated from the sample due to high LSC scores, as in the other studies carried out in the project. The remaining 144 children were grouped into low, middle, and high anxious groups based on their TASC scores. Children were also grouped according to whether they came from regular or advanced math classes in the schools.

Children performed at arithmetic computations and then arithmetic word problems for a total of 30 minutes after being randomly assigned to one of four testing conditions: (1) standard instructions, in which the tasks were introduced as a test of their ability, (2) diagnostic instructions, in which the child was told the test results would be used to help him learn math, (3) expectancy-reassurance instructions, in which the child was told the problems were difficult, most children got quite a few wrong, and not to worry if he couldn't do some of them, and (4) normative instructions, in which the child was told individual performance was not of interest (and he should not write his name on the booklet), but rather that how children solved the problems and whether they liked them was of primary interest. The normative condition thus de-emphasized evaluation in general. Except for these differences in instructions, all children took the two arithmetic subtests under identical conditions, under the same time limits, etc. Dependent measures included errors, time per problem, number attempted, and number correct for each subtest.

Study 3. Test Anxiety, Social Evaluation, and Risk Taking

Study 3 tested hypotheses from the Hill (1972) model for low, middle, and high anxious children's choices and performance at a task involving risk taking, one at which they could choose easy or difficult designs to complete. The risk-taking paradigm used in the research is discussed in the journal paper in Appendice 6 under the authorship, Hill, 1976. It was expected that, in general, high test anxious children would show less risk taking than low anxious children and that children would show less risk taking when later adult evaluation of their performance was promised than when later evaluation was not expected or possible. In addition, it was expected that social evaluation from adults would inhibit the risk taking of high test anxious children moreso than less anxious children.

The subjects for Study 3 were 36 boys and 36 girls from the fourth- and fifth-grade chosen from a larger sample of 99 children for whom TASC and LSC scores were available. Low and high test anxious groups of each sex were formed after excluding children with high LSC scores or TASC scores near the median for the sample. Children performed at a puzzle design task developed specifically for the research. On each of five trials, the child had a choice of completing one of five designs by placing 16 blocks from the WISC IQ Test into a form-board in a 4 x 4 block matrix. Each block had solid red, solid white, and diagonally split red/white sides. The five designs ranged from very easy (solid red design calling for all 16 blocks with solid red sides up), to intermediate (e.g. checkerboard pattern calling for solid red and solid white sides up in alternate parts of the matrix) to very difficult (random shapes involving many diagonal red/white sides up). Pretesting revealed that elementary school children perceived the five levels of designs as differing in difficulty as intended.

Children chose and completed one design from each of five sets under one of two conditions to which they were randomly assigned: (1) an evaluative condition in which the children were told to leave the designs they had completed on a table and come get the adult, who would tell the child whether

he did well or poorly (since the task is one for which all children complete all puzzles attempted, all children were told they had done very well in completing the designs they tried), and (2) a no evaluation condition in which the children were told to dump the puzzle pieces and formboards into piles which contained materials from other children who had previously worked at the puzzles, and then return with the adult to the classroom. Major measures were the average difficulty of the child's choice, the latency (in seconds) of his choice, and how long it took the child to do the designs chosen (in seconds).

Study 4. Test Anxiety and Off-Task Behavior

Study 4 was an extra study that was possible to carry out during the grant period in addition to the other four studies in the areas originally proposed for investigation. Study 4 tested the hypothesis that one of the major determinants of high test anxious children's poor performance at academic tasks is their tendency to spend more time off-task than less anxious children. A full length journal-style paper reporting in detail the rationale, method, findings, and conclusions for this study is presented in Appendice 7, under the authorship, Nottelmann & Hill, 1975. Briefly, it was expected that high test anxious children would perform more poorly on a verbal learning task and glance away from the task at a higher rate than less anxious children.

The subjects for Study 4 were 48 fourth- and fifth-grade children from two elementary schools chosen from a larger sample of 76 children for whom TASC and LSC scores were available. Low and high test anxious groups were formed by excluding children with high LSC scores and TASC scores near the median for the sample. All children performed at two consecutive anagram tasks in a single, clearly evaluative condition in the presence of an experimenter who also worked on anagrams. Frequency and direction of off-task glancing was the major measure of attention, including glances at the experimenter, at the experimenter's task, and nondirected glances elsewhere around the testing room.

Study 5. Test Anxiety and the Meaning of Non-reaction

Study 5 tested hypotheses concerning how children in general interpret non-reaction from an adult in an observational situation and tested for whether low and high anxious children differ in this regard. A full length journal reprint of the report describing in detail the rationale, methods, fidings, and conclusions from this study is included in Appendice 8 under the authorship, Hill, Emmerich, Gelber, Lazar, & Schickedanz, 1974. Briefly, Spence (1966) had found that children learn a two-choice verbal learning task more rapidly when told which choices are wrong but given no feedback on right answers ("wrong-blank" feedback) than when they are told when they are right but the adult fails to react when they are wrong ("right-blank" feedback). In the present research, children watched as an adult gave feedback to another child working at a two-choice task the subject could not see. It was expected that children would interpret adult non-reaction to mean the opposite of the overt feedback it was paired with, since their own performance was not being evaluated and informational rather than motivational aspects of

non-reaction should be operative. It was thought that children of all anxiety levels would show such a contrast effect since success/failure and approval/disapproval motives were operating minimally.

The subjects for Study 5 were 64 third- and fourth-grade children chosen from a larger sample of 106 children for whom TASC and LSC scores were available. Low and high test anxious groups were formed by excluding children with high LSC scores and TASC scores near the median for the sample. Children watched while an adult tested another child for 66 trials at a two-choice task. After six initial blank (nonreaction) trials, children observed one of four feedback condition schedules to which they were randomly assigned: (1) Rb sequences in which the child observed 50% right and 50% nonreaction feedback, (2) Wb sequences in which the child observed 50% wrong and 50% nonreaction feedback, (3) RWb sequences in which the child observed right, wrong, and nonreaction each on 33% of the trials, and (4) all blanks in which the child observed only adult nonreaction. The major measure was whether the the observing child thought the other child was right, wrong, or he didn't know if he was right or wrong on each trial.

## 4. Results

### Study 1. Test Anxiety and Success-Failure as Determinants of Performance

The Hill model predicts a significant anxiety by treatment interaction in the pattern of scores for the five dependent variables, with differential performance favoring low anxious children in the mixed success/failure condition and improved and possibly superior performance by high anxious children in the success only condition. In the anxiety X treatment X sex multivariate analysis of variance (MANOVA) for rate, off-task behavior, accuracy, cheating and persistence, the anxiety by treatment two-way interaction was found to be very significant, multivariate $F$ (10.88) = 2.46, $p < .02$. No other interactions or main order effects were significant. The means for the interaction of anxiety by treatment are presented for the four interrelated performance measures in Figure 3, Appendice 2, and for the persistence measure in Figure 4, Appendice 2.

Inspection of Figure 3 reveals that in the mixed success/failure condition, high anxious children, as expected, showed inferior performance to low anxious children on all four performance measures, taking more time per problem, spending more time off-task, making more errors, and cheating more. In the success only condition, in contrast, performance differences between high and low anxious children were much smaller due to the predicted improvement in high anxious children's performance. Compared to performance of high anxious children in the mixed success/failure condition, high anxious children in the success only condition worked much faster, spent less time off task, made fewer errors, and cheated less. Low anxious children's performance improved slightly for subjects in the success only condition. Middle anxious children's performance was generally intermediate to that of low and high anxious children (see Figure 3).

Inspection of Figure 4, which depicts the results for the persistence measure, reveals a different and unpredicted pattern of means for the anxiety by treatment interaction. High anxious children persisted longer than low anxious children in both conditions, and both low and high anxious children attempted more problems in the mixed than in the success only condition. In contrast, the middle anxious children persisted less than low and high anxious children in the mixed condition but persisted more than these other children in the success only condition.

Study 2. Test Anxiety, Optimizing Instructions, and Arithmetic Test Performance

A. Interaction of Test Presentation with Anxiety

A significant two-way interaction of Test Presentation X Anxiety was found in the analysis of proportion correct for computation problems, $F$ (6, 96) = 2.46, $p < .05$, but not for word problems, $F$ (6, 96) = 1.03). The significant interaction for the computation problems supported the predictions of the study. As can be seen in Figure 5, Appendice 2, high anxious subjects showed increasing accuracy going from standard to diagnostic to expectancy-reassurance conditions, and greatest accuracy of all 12 groups in the normative condition. Conversely, although the differences were small, low and middle anxious subjects did better in the standard and diagnostic conditions than in either the expectancy-reassurance or the normative condition, resulting in the significant cross-over interaction.

B. Interaction of Test Presentation, Anxiety, and Math Class

The means in the significant three-way interaction of Test Presentation X Anxiety X Math Class, $F$ (6, 96) = 2.26, $p < .05$, for proportion correct for the word problems are presented in Table 1, Appendice 1. As can be seen, performance accuracy of the different anxiety groups was exactly as predicted for children in the regular math class. In the standard condition, high anxious children were significantly less accurate than either low or middle anxious subjects. Across conditions, high anxious children showed significantly greater accuracy ($M$ = 69%) in the expectancy-reassurance condition compared to the standard ($M$ = 38%) condition. Performance accuracy was somewhat improved for high anxious children in the normative compared to the standard condition. As can be seen in Table 1, low and middle anxious children showed small decreases in accuracy between the standard and the other three test presentation conditions.

For children in the advanced math classes, performance was generally quite accurate (see Table 1). High anxious advanced math children were significantly more accurate in the standard condition ($M$ = 79%) than the regular math class, high anxious subjects in this condition ($M$ = 38%). High anxious advanced math subjects performed about as accurately as advanced math middle anxious and low anxious children in this condition.

The three-way interaction of test presentation, anxiety and math class was also significant for mean time per problem, $F$ (6, 96) = 2.21, $p < .05$, and means bearing on this interaction are presented in Table 2, Appendice 1. The amount of time spent on each problem by different

groups of children, in combination with the measure of proportion correct, suggested different strategies of performance at the task and also clarified the effects of conditions on subjects' total number of correct solutions. For example, advanced math high anxious children showed much faster performance in the expectancy-reassurance condition ($\underline{M}$ = 33.6 seconds per problems) for which performance on proportion correct had decreased only somewhat ($\underline{M}$ = 69%) compared to the standard condition ($\underline{M}$ = 50.3 seconds per problems, $\underline{M}$ = 79%).

In summary, high anxious advanced math subjects performed slowly, but accurately in the standard condition and improved their performance in the expectancy-reassurance condition by performing much more quickly but with very little loss in accuracy. Advanced math, high anxious children had more correct solutions in the expectancy-reassurance condition ($\underline{M}$ = 25.8) than in the standard condition ($\underline{M}$ = 20.8).

A different pattern of findings was obtained for regular math, high anxious children in the standard and expectancy-reassurance conditions. In the standard condition, these high anxious, regular math subjects who had shown very poor performance accuracy (Table 1) showed a tendency, although not significant, to take less time per problem than high anxious children in the expectancy-reassurance condition in which performance accuracy was significantly higher. These results suggest that the regular math, high anxious children performed quickly but inaccurately in the standard condition, and the effects of the expectancy-reassurance condition was to slow them down and increase accuracy. The result of the high anxious, regular math subjects working more slowly on the problems, but performing significantly more accurately was to increase their total number of correct problems done for this group in the expectancy-reassurance ($\underline{M}$ = 17.4) compared to the standard condition ($\underline{M}$ = 12.5).

Study 3. Test Anxiety, Social Evaluation and Risk Taking

A MANOVA for the three dependent measures of choice, latency, and completion time revealed significant main-order effects for evaluative condition ($\underline{F}$ (3,58) = 4.38, $\underline{p} < .01$), anxiety level ($\underline{F}$ (6,116) = 2.60, $\underline{p} < .025$), and trials (F (12,630) = 3.25, $\underline{p} < .001$) but no significant interactions.

Univariate tests indicated that the significant evaluative condition effect was due primarily to results for the time measure ($\underline{p} < .01$). As expected, children worked faster in the evaluative condition (72 seconds per problem) than the no-evaluation condition (95 seconds per problem). In contrast, the significant overall anxiety level effect was due primarily to results for the choice measure ($\underline{p} < .05$). Again, as expected, low anxious children chose more difficult problems (3.7 on 5.0 scale, 5 most difficult) than middle anxious (3.2) or high anxious (3.0) children. There was also a tendency ($\underline{p} < .15$) for high anxious children to take more time to choose their designs and to work through the puzzles more quickly. Finally, the significant overall effect for trials was due largely to the choice measure. As expected, since children completed all designs, there was a tendency to

choose more difficult designs across the five trials (average choice of 2.9, 3.1, 3.4, 3.4, and 3.6 for trials 1-5, respectively. The tendency for social evaluation to reduce risk taking was not found to be significantly stronger for high than for low test anxious children.

Study 4. Test Anxiety and Off-Task Behavior

A. Performance Scores

The overall analysis yielded significant effects for anxiety level ($F$ {2,36} = 6.12, $p < .01$) and grade ($F$ {1,36} = 7.13, $p < .05$). The middle anxious subjects achieved the best performance scores ($\bar{X}$ = 16.3), low anxious subjects were next ($\bar{X}$ = 13.8), and high anxious subjects showed the poorest performance ($\bar{X}$ = 11.5). Fourth-graders formed fewer words ($\bar{X}$ = 12.3) than fifth-graders ($\bar{X}$ = 15.4).

B. Off-Task Glances

The overall analysis of off-task glances summed over categories yielded significant effects for anxiety ($F$ {2,36} = 3.55, $p < .05$) and grade ($F$ {1,36} = 5.13, $p < .05$). High anxious children glanced away from their task much more frequently ($\bar{X}$ = 8.59) than either middle anxious ($\bar{X}$ = 5.41), or low anxious children ($\bar{X}$ = 5.28), (see Figure 6, Appendice 2). Fourth-graders glanced away from their tasks more frequently ($\bar{X}$ = 7.73) than fifth-graders ($\bar{X}$ = 5.13).

An overall analysis of glances directed at the experimenter's task yielded a significant anxiety effect ($F$ {2,36} = 4.53, $p < .05$) in the expected direction. High anxious subjects looked at the experimenter's task at a higher rate ($\bar{X}$ = 3.69) than either low anxious ($\bar{X}$ = 2.16) or middle anxious ($\bar{X}$ = 2.00) subjects. No significant anxiety level differences were found, however, in the overall analysis of glances directed at the experimenter (see Figure 6).

Finally, the overall analysis of nondirected glances--glances directed neither at the experimenter's task nor at the experimenter--revealed a significant anxiety effect ($F$ {2,36} = 3.91, $p < .05$). High anxious children exhibited nondirected glancing at a substantially higher rate ($\bar{X}$ = 2.31) than middle anxious ($\bar{X}$ = .94) or low anxious subjects ($\bar{X}$ = .88), (see Figure 6).

Study 5. Test Anxiety and the Meaning of Nonreaction

Results were quite strong and as expected in analyses of children's choice of right, wrong, or don't know in interpreting the performance accuracy of the child being observed. To anticipate major findings to follow: (a) in the Rb and Wb conditions children showed an early and very strong tendency to interpret b as meaning the opposite of the overt reinforcer, (b) in the RWb condition children tended to indicate that they didn't know what b meant, (c) in the all blanks condition children continued the tendency to show a slight preference for R over W over DK, and (d) test anxiety and sex of subject effects were minimal during the experimental period. The mean per cent of right,

wrong, and don't know responses on b trials during the experimental period for subjects in the different feedback combination groups is presented in Figure 7, Appendice 2.

A. Choice of Right

The 4 x 2 x 2 x 2 analysis of R responses during the first 20 blank trials of the experimental period revealed a highly significant feedback combination effect ($F = 66.0$, $df = 3/32$, $p < .001$), with no other significant main-order or interaction effects. An estimate of the population variance accounted for by the experimental and subject variables indicated that virtually 100% of the between-group variance and 76% of the total variance is accounted for by the feedback combination main-order effect. As can be seen in Figure 7, subjects in the Wb condition showed a very strong tendency to choose R (75% of their choices), subjects in the Rb condition consistently avoided this choice (8% of choices), and children in the RWb and all blanks conditions chose R, an intermediate amount (27% and 42% respectively), indicating a very strong contrast effect in the Rb and Wb conditions.

B. Choice of Wrong

The 4 x 2 x 2 x 2 analysis of W choices during the first 20 blanks of the experimental period also revealed a highly significant feedback combination effect ($F = 40.0$, $df = 3/32$, $p < .001$). The feedback combination effect accounted for an estimated 91% of the between-group population variance, and 61% of the total variance. As can be seen in Figure 7, subjects in the Rb condition showed a very clear tendency to choose W (67%) and children in the Wb condition consistently avoided that choice (6%), again a very strong contrast effect, while subjects in the RWb (31%) and all blanks (34%) conditions revealed an intermediate choice of W.

C. Choice of Don't Know

The 4 x 2 x 2 x 2 analysis of DK responses during the first 20 experimental period blank trials revealed a weaker but still clear and significant feedback combination effect ($F = 4.55$, $df = 3/32$, $p < .01$). The feedback combination effect accounted for an estimated 17% of the between-group population variance and 13% of the total variance. As can be seen in Figure 7, subjects in the RWb condition chose DK more frequently (41%) than subjects in the Rb (25%), Wb (19%), and all blanks (23%) conditions.

5. Conclusions

Study 1. Test Anxiety and Success-Failure as Determinants of Performance

The results generally support Hill's (1972) model of motivational processes underlying effects of evaluation anxiety. The multivariate analysis revealed a highly significant interaction between the child's self-report of anxiety and his success/failure experience for the five dependent measures of rate, time off-task, accuracy, cheating, and persistence. With regard to specific

predictions from Hill's model, results were clear-cut and as expected for the four performance measures but less consistent and not as predicted for the persistence measure.

Results for the four performance measures of rate, time off-task, accuracy, and cheating were exactly as predicted. Under mixed success and failure, high anxious children showed inferior performance to low anxious children, with the former taking almost twice as long per problem, spending almost twice as much time off-task, making three times as many errors, and cheating twice as often. Under success only, however, high anxious children almost matched the performance of their low anxious counterparts (who themselves did slightly better), going almost as fast, spending as little time off-task, making just a few more errors, and cheating only somewhat more often. In general, performance of middle anxious children was intermediate to that of low and high anxious children. Thus the interfering effects of evaluation anxiety were dissipated in the success only condition, designed to minimize failure motifes and to allow success motives to predominate.

It is noteworthy that high anxious children did almost as well as low anxious children in the success only condition for all four performance measures. If the anxious children had increased speed but at the expense of making more errors or had improved their accuracy but at the expense of maintaining a very slow rate, implications for achievement testing and classroom learning would be less striking. The fact that high anxious children both went as fast and were as accurate as less anxious children in the success only condition suggests that anxious children have the specific skills necessary to perform well on basic addition problems, although they fail to do so under testing conditions typical of those used in school. These results indicate that anxious children perform poorly on such tests due to motivational difficulties rather than to learning or ability deficiencies (see Hill, 1972; Zigler & Harter, 1969). Moreover, the research suggests that such highly evaluative testing procedures systematically underestimate the abilities and achievement of many anxious children with histories of failure in school (Hill & S. B. Sarason, 1966).

Study 2. Test Anxiety, Optimizing Instructions, and Arithmetic Test Performance

Results for interactions involving test presentation, test anxiety, and math class supported several of the hypotheses derived from the Hill (1972) model of test anxiety and revealed several unexpected findings. Most of the major significant results were obtained in the analyses of proportion correct for both computations and word problems. In general, high anxious children were more strongly affected by the test presentations than low and middle anxious children, similar to findings with adults (I. G. Sarason, 1972). The accuracy and rate (time per problem) data taken together suggested quite different facilitating effects for the advanced versus regular math class anxious children on the word problems task, and for the expectancy-reassurance versus normative conditions in general.

The findings lead to a refinement in the general conclusion that high anxious children are cautious in problem solving situations (Ruebush, 1963;

Hill, 1972). Cautious strategies often have been studied for non-intellectual, game-like tasks (see Williams & Hill, 1975). The present results suggest that in highly evaluative academic situations, high anxious children with a history of failure such as those in the regular math classes perform rapidly and inaccurately at the task, a maladaptive avoidance strategy perhaps intended to terminate a threatening, unpleasant situation as soon as possible. The expectancy-reassurance condition facilitated performance of these anxious children by encouraging them to slow down somewhat and show significantly greater accuracy (69%), with a resulting trend of improving by about five more problems correct between the standard and the expectancy-reassurance condition, from 12 to 17. In contrast, it was the high anxious children from the advanced math classes with a greater history of success that showed an unnecessarily slow and cautious approach to problem solving in the highly evaluative standard condition representative of most achievement and school tests. The expectancy-reassurance condition facilitated performance of these anxious children by enhancing their performance rate, a significant change for the computation problems, with little or no loss in accuracy.

The improved performance, in terms of proportion correct, of high anxious subjects in the expectancy-reassurance condition compared to the standard and diagnostic conditions indicates that such high anxious children may have more ability than they typically demonstrate in achievement test situations. The results suggest that in testing situations where power is assessed independently of speed of performance, high anxious subjects with a history of failure may optimize their performance when fear of failure or disapproval is reduced by performing accurately but somewhat more slowly. Although the absolute number of problems was not significantly affected by test presentation or anxiety, there was a tendency for high anxious subjects from both math classes to obtain about five more problems correct in the expectancy-reassurance than the standard condition on the word problem data.

Study 3. Test Anxiety, Social Evaluation, and Risk Taking

The significant effects obtained in Study 3 were all in the predicted direction but not all of the hypotheses were confirmed. The significant anxiety effect for the choice measure reflected the expected tendency for low test anxious children to show maximum risk taking and high test anxious children to show least risk taking. In addition, children in general took more time on the puzzles they completed in the no evaluation condition than when expecting later adult evaluation. Children also showed a general tendency to choose more difficult designs across the five trials as they succeeded on each design attempted. These effects for test anxiety and social evaluation show the importance of each variable as determinants of risk taking and attest to the validity of the puzzle task developed for this research.

It was hypothesized that promised later evaluation from an adult would lower risk taking of high test anxious children to a greater extent than for less anxious children due to the former children's greater concern over disapproval. There may be several reasons why a significant interaction between test anxiety and evaluative condition failed to occur. For one thing, children completed all of the designs attempted, albeit high anxious children chose easier ones, which may have lowered the strength of the failure and disapproval

motives. In addition, the game-like nature of the task and testing situation may also have weakened achievement-related motives. It would be of interest to test further for possible interactions of test anxiety and social aspects of evaluation and for even stronger main effects on more difficult academic tasks (see Hill, 1976).

Study 4. Test Anxiety and Off-Task Behavior

The major finding in the present study was that high anxious children, as expected, had the lowest performance scores and exhibited substantially more off-task glancing than low and middle anxious children. Middle anxious children, however, outperformed low anxious children on the anagram tasks, although both middle and low anxious children showed similar glancing patterns. These findings were general to the sample and did not interact with the child's sex or with his age and school.

It is noteworthy that both the rate of word formation and the rate of off-task glancing covaried in relation to anxiety. Low and middle anxious children showed less off-task glancing and did better at the task than high anxious children. The high anxious children's significantly higher rate of off-task glancing, both at the experimenter's task and especially elsewhere in the room, offers support for the hypothesis that high anxious children, who typically perform poorly in evaluative situations (Hill, 1972; Hill & Sarason, 1966), tend to avoid performing at tasks by looking completely away from the task. Such a marked tendency to exhibit off-task glancing may account in good part for anxious children's lower performance.

The high anxious children's significantly higher rate of glancing at the experimenter's task also suggest that these children may have been seeking clues toward solution of their anagram rather than trying to solve the problem on their own. This significant tendency of high anxious children to glance more at the experimenter's task than low and middle anxious children showed little change across the five minutes of the tasks. Since no specific word information was to be gleaned, however, this tendency to continue glancing at the experimenter's task would suggest that high anxious children were either unable or unwilling to abandon their external orientation; or further, that they lacked the flexibility that would permit them to select and/or change to an appropriate strategy based on task-inherent feedback and make a deliberate effort to generate words on their own (see Hill, 1972).

The results of the present study indicated that high anxious and less anxious children differ in the way they attend to a task under evaluative conditions. The findings suggest that anxious children's performance can be improved by increasing their on-task orientation through task-inherent direction (e.g., programmed instruction) and task-relevant feedback. Test anxiety research with adults (e.g., I. G. Sarason, 1972) suggests that modeling of problem solving with the verbalization of strategy facilitates subsequent performance of high anxious individuals. To help anxious children in the classroom, then, teachers could model problem-solving strategies, especially when introducing new material, and formulate rules to help children attend to the relevant parameters of the task. Finally, teachers could encourage anxious children to evaluate their own performance at the task and also provide them with strategies for assessing task-related feedback rather than to be overly reliant on external evaluation.

Study 5. Test Anxiety and the Meaning on Non-Reaction

The present study produced clear results concerning the questions of the generalized and contextual determination of the meaning of blank reactions in an observational context for middle grade-school children. There was overwhelming evidence for a contrast effect in both the Rb and Wb feedback conditions. In contrast, there was relatively little support for the position that children of this age have a generalized tendency to interpret blank reactions as meaning that they are right.

The present results, of course, are consistent with and support the general position that blank reaction acquires informational value opposite to that of overt feedback with which it is paired in an evaluative context, and extend such a process to the observational context. The work of Meyer and others has suggested such a contrast effect when feedback is mixed within a learning task. The cited work of the Crandalls suggests that such a contrast effect occurs when blank reactions follow blocks of positive or negative overt feedback. The present results also suggest the possibility that such a contrast may occur when the child experiences non-reaction while an adult or another child in the same situation is receiving positive or negative reactions from an adult. Thus if a school teacher or parent is examining the performance of two (or more) children and gives positive (or negative) feedback to one child but fails to respond to the other child, the latter child may interpret the teacher's non-reaction as evaluative and meaning the opposite of the overt feedback provided the first child. There are presumably many possibilities for such a contrast process in observational contexts both in classroom and home environments in which teachers or parents often respond to some children but not others in evaluative situations.

In the present study children learned the contextual meaning of blank reaction quickly and about equally well in the Rb and Wb conditions; that is, children were as able and about as likely to interpret b as meaning wrong in the Rb condition as meaning right in the Wb condition. Presumably this rapid and equally strong learning could be detected because the child was neither having to learn the two-choice discriminations himself nor was being evaluated by the experimenter, so that effects of other cognitive and motivational processes were minimal.

General Conclusions

The program of research completed during the grant has a number of general implications both for motivational theory and educational practice. With regard to theory, the findings generally supported the Hill (1972) model of children's development of achievement related motives. The importance and predictable effects of success/failure and approval/disapproval motives was seen in a number of studies. Study 1 demonstrates that high anxious children's poor performance under time pressure and when failing one-third of the problems attempted is completely reversed when failure is removed from the situation. Study 2 shows that by lowering children's criteria for successful performance in an achievement test situation and the likelihood of adult disapproval for less than perfect performance, the interfering effects of evaluation anxiety are again reversed. Study 3 suggests further that anxious children will not

expose themselves to tasks of intermediate or greater difficulty, nor will children in general when later adult evaluation is expected and disapproval possible. Finally, Study 5 shows that high anxious as well as low anxious children can process the meaning of non-reaction from an adult when the child himself is not being evaluated, in this case when observing another child. Possible failure and disapproval thus play a major role in interfering with high anxious children's learning and performance on academic tasks.

The present studies also help clarify some of the theoretical processes mediating the interfering effects of anxiety. Study 4, for example, suggests that off-task avoidance behavior is an important factor in anxious children's poor performance at learning tasks. Study 2 indicates that children's expectations and criteria for successful performance and subsequent adult approval or disapproval strongly influences anxious children's performance on arithmetic achievement tasks. Anxious children doing well or poorly in school differ further in the strategies they follow in doing academic tasks, the more successful children following a cautious, accurate approach while children with a greater history of failure showing an impulsive, inaccurate approach. The role of children's attributions of the outcome of their performance strategies and effects of social aspects of evaluation from adults need further examination.

With regard to practice, the research has implications for both classroom instruction and ability/achievement testing. The findings suggest that test anxiety is an important motivational factor interfering with performance of many children. Studies 1 and 2 demonstrate, however, that under certain conditions anxious children can perform quite well both on arithmetic tasks typical of those learned in the classroom and those used on achievement tests. The research shows that anxious children have greater ability and achievement than they typically show in highly evaluative educational testing situations, and much of their poor performance in school and on tests is due to motivational rather than cognitive/learning deficiencies. The research suggests ways of changing testing and assessment procedures to better estimate these children's learning and achievement, e.g. the elimination of time limits and more information to the child about the adult's expectations concerning the child's performance. The research also suggests ways classroom teachers can help anxious children develop more effective strategies in school learning and test situations, e.g. attending to and spending more time on task, obtaining an optimal balance of rate and accuracy, and exposing themselves to tasks involving a fairly high probability of initial failure.

The theoretical and educational implications of the research are explored in greater detail in the six papers resulting from the research project presented in Appendices 4 through 9.

## 6. Recommendations

A number of specific implications and recommendations of the research program have been discussed in summaries of the studies and conclusions drawn from them. Several general recommendations will be discussed here. First, in showing that achievement-related motives are important determinants of

children's performance on classroom learning and ability/achievement test situations, the research suggests that greater attention should be paid to such motivational variables both in research and educational practice. A fairly large number of children in our culture show the high anxiety-low performance pattern found in most of the present studies. Children experiencing anxiety and failure come from all socio-economic levels and over time represent a considerable proportion of students with serious school and other problems (see Hill & Sarason, 1966). It is clear that a good deal more research is needed in this area to develop further a specific and comprehensive theory of how achievement-related motives develop and function. More research is also needed to further develop and implement applications of this research to the classroom teaching and ability/achievement testing situations in order to facilitate all children's optimal learning and performance.

The optimizing testing research illustrated by Studies 1 and 2 is a crossroad between basic and applied research that appears to be an especially promising approach. Such research represents both a theoretical test of the factors believed to underlie effects of undue evaluation anxiety and a practical demonstration that anxious children have learned more and can perform better in classroom learning and educational testing situations than they do under typical present conditions. The present findings offer encouraging evidence that the academic work of many children can be significantly enhanced by further research and practitioner efforts in these directions.

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Appendix

Appendice 1. Tables 1 and 2

Appendice 2. Figures 1-7

Appendice 3. Psychometric Instruments:

a. Test Anxiety Scale for Children
b. Lie Scale for Children

The remaining appendices are six full-length papers coming from research carried out for the grant (attached)

Appendice 4. Hill, K. T., & Eaton, W. O. The interaction of test anxiety and success/failure performance in determining children's arithmetic performance. Pending editorial decision, 1975.

Appendice 5. Williams, J. P., & Hill, K. T. Performance on achievement test problems as a function of optimizing test presentation instructions and test anxiety. Pending editorial decision, 1975.

Appendice 6. Hill, K. T. Individual differences in children's response to adult presence and evaluative reactions. Merrill-Palmer Quarterly, 1976. In press.

Appendice 7. Nottelmann, E. D., & Hill, K. T. Test anxiety and off-task behavior in evaluative situations. Pending editorial decision, 1975.

Appendice 8. Hill, K. T., Emmerich, H. J., Gelber, E. R., Lazar, M. A., & Schickedanz, D. Children's interpretation of adult non-reaction: A trial-by-trial self-report assessment and evidence for contrast effects in an observational context. Journal of Experimental Child Psychology, 1974, 17, 482-494.

Appendice 9. Hill, K. T. Developmental changes and individual differences in children's reaction to negative evaluation. Symposium paper presented at the biennial meetings of the Society for Research in Child Development, April, 1975.

Appendice 1

Table 1

Mean Proportion Correct for Word Problems
as a Function of Test Presentation,
Anxiety and Math Class

| Math Class | Anxiety | Test Presentation | | | |
|---|---|---|---|---|---|
| | | Standard | Diagnostic | Expectancy-Reassurance | Normative |
| Advanced | Low | .84 | .77 | .85 | .78 |
| | Middle | .80 | .77 | .76 | .84 |
| | High | .79 | .81 | .69 | .76 |
| Regular | Low | .77 | .60 | .60 | .61 |
| | Middle | .67 | .54 | .56 | .55 |
| | High | .38 | .43 | .69 | .49 |

Appendice 1

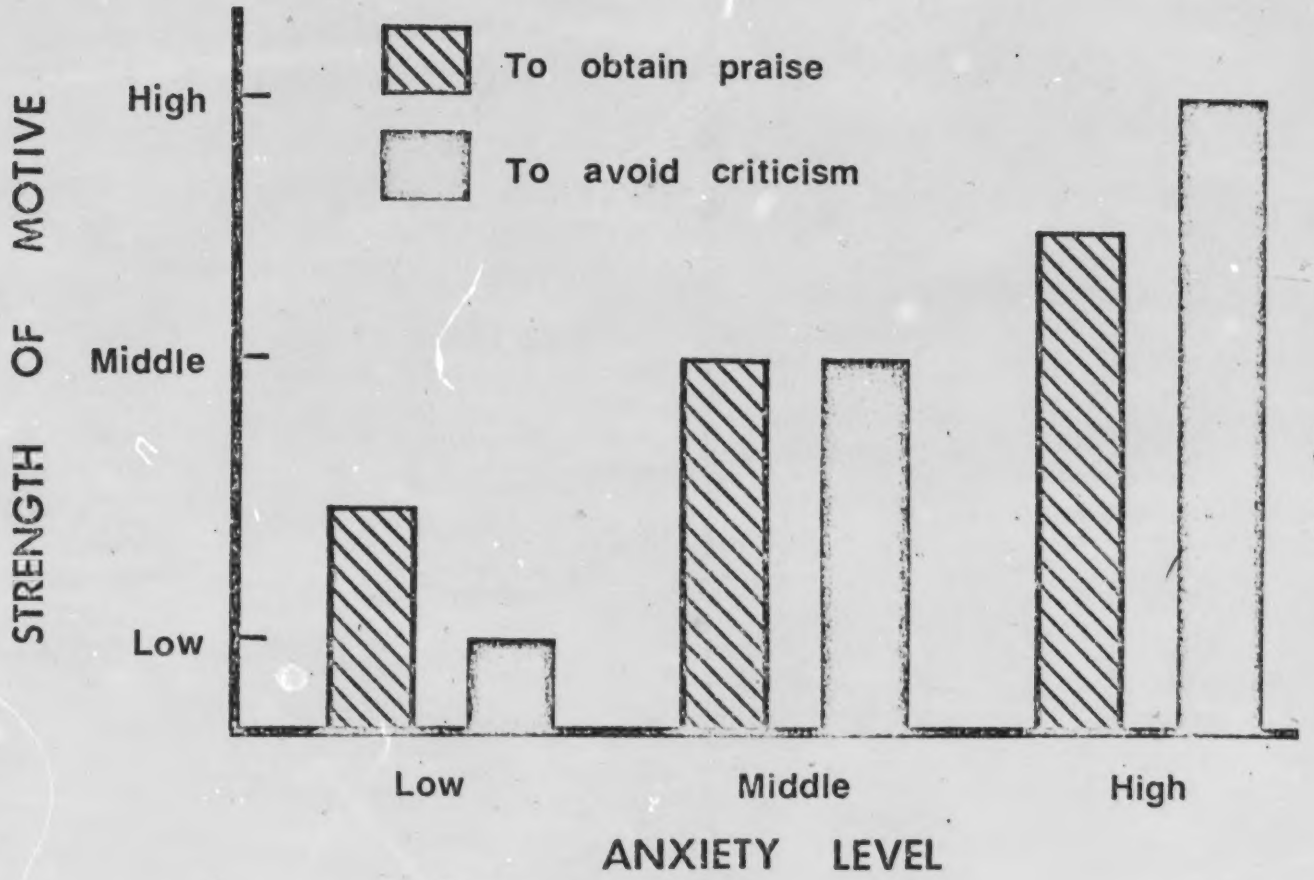
Table 2

Mean Time Per Word Problem, in Seconds,
as a Function of Test Presentation,
Anxiety and Math Class

| Math Class | Anxiety | Test Presentation | | | |
|---|---|---|---|---|---|
| | | Standard | Diagnostic | Expectancy-Reassurance | Normative |
| Advanced | Low | 41.1 | 39.4 | 46.7 | 46.3 |
| | Middle | 41.8 | 37.2 | 41.6 | 50.5 |
| | High | 50.3 | 49.2 | 33.6 | 41.2 |
| Regular | Low | 57.6 | 48.0 | 42.6 | 46.4 |
| | Middle | 48.5 | 51.2 | 41.5 | 39.2 |
| | High | 41.4 | 45.4 | 48.6 | 91.7 |

Appendice 2

Figure 1



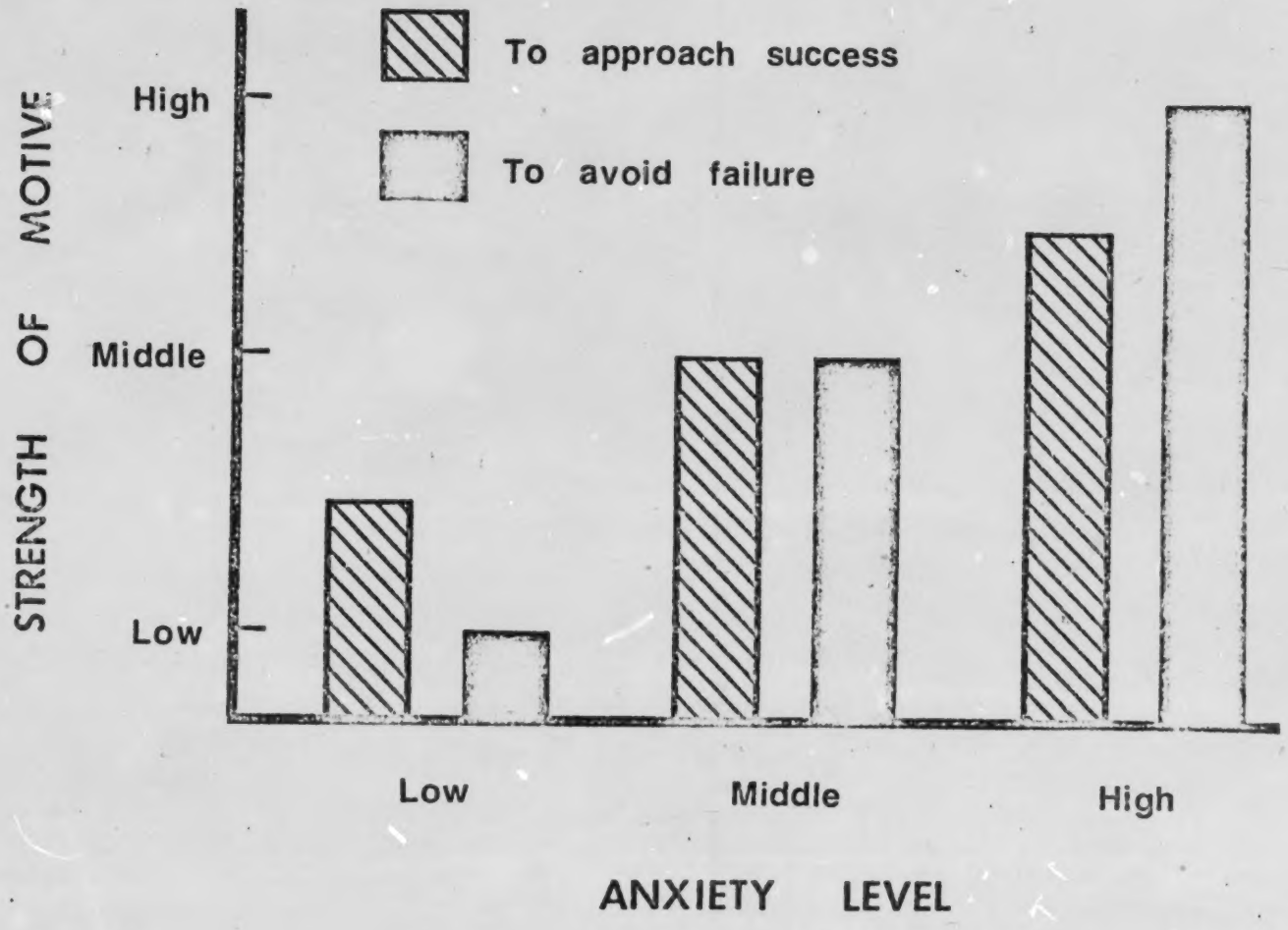
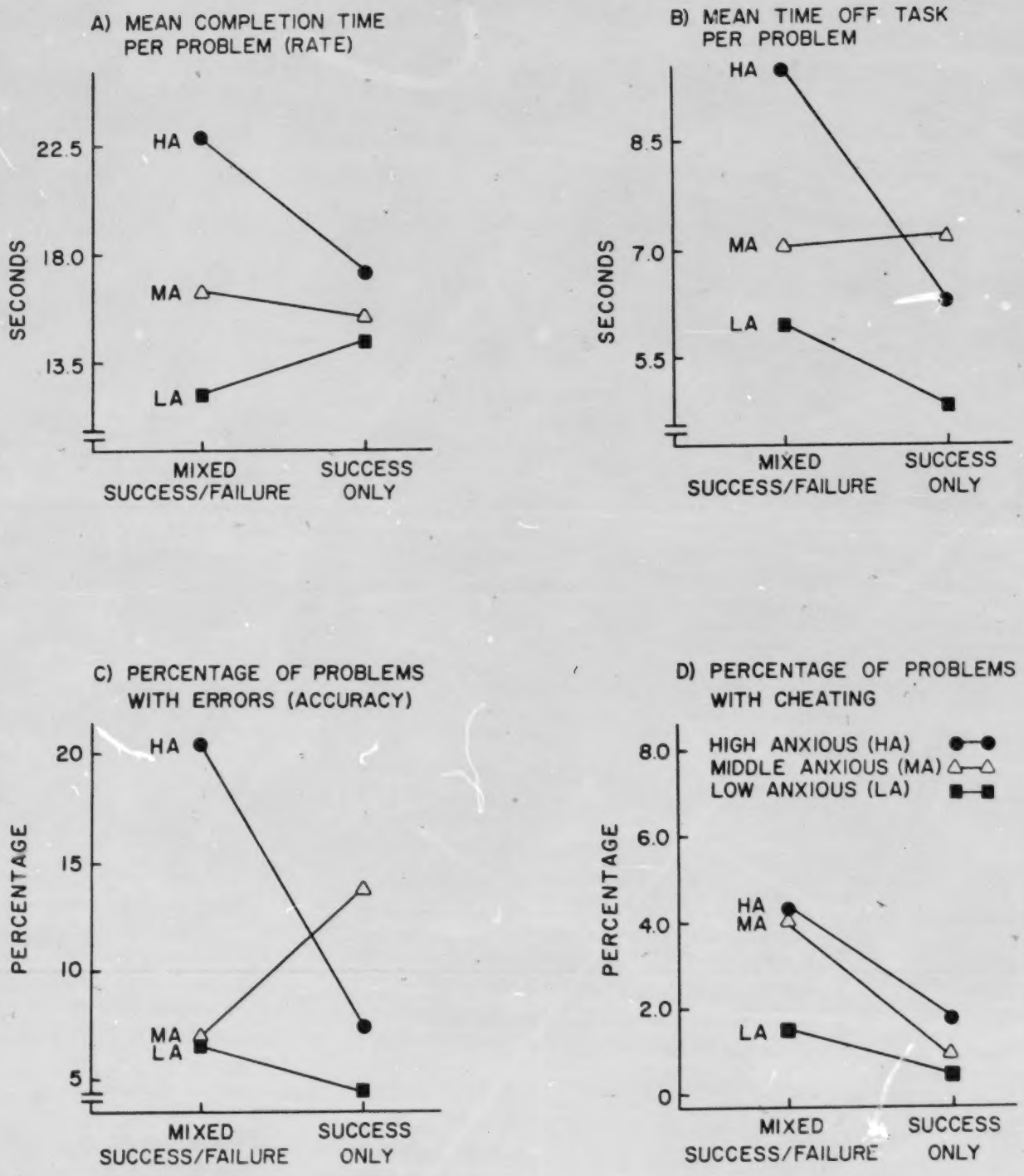

To approach success
To avoid failure
STRENGTH OF MOTIVE
High
Middle
Low
Low
Middle
High
ANXIETY LEVEL

Figure 2

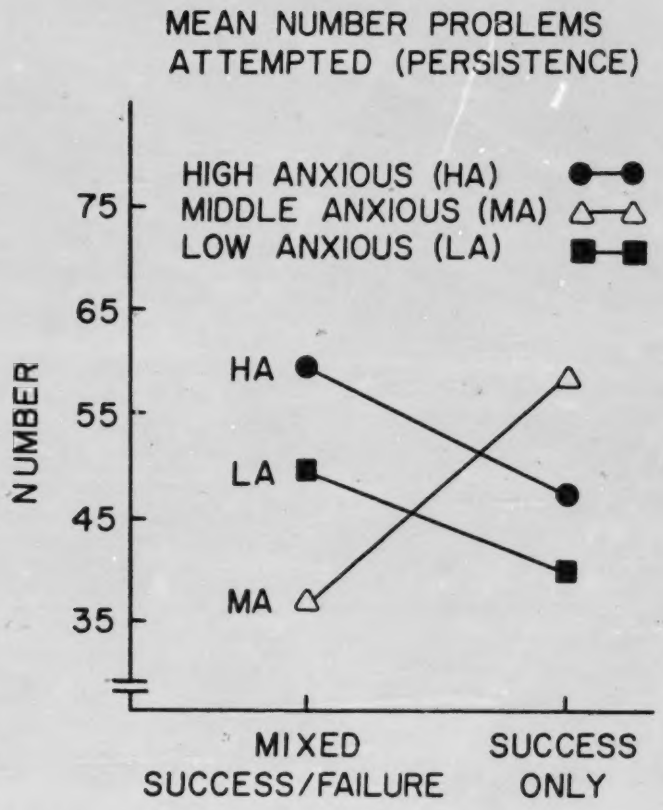
Appendice 2

Figure 3



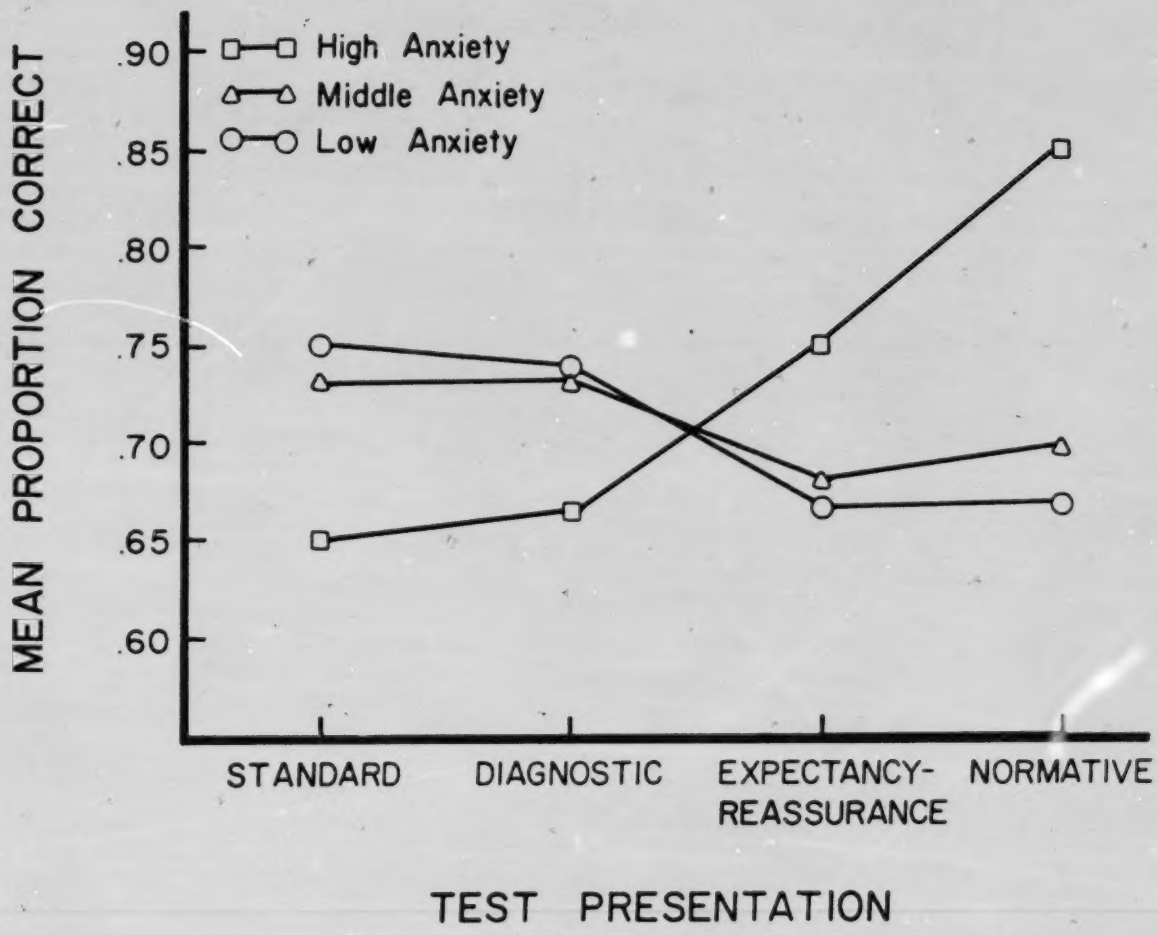
Appendice 2

Figure 4



Appendice 2

Figure 5



Appendice 2

Figure 6

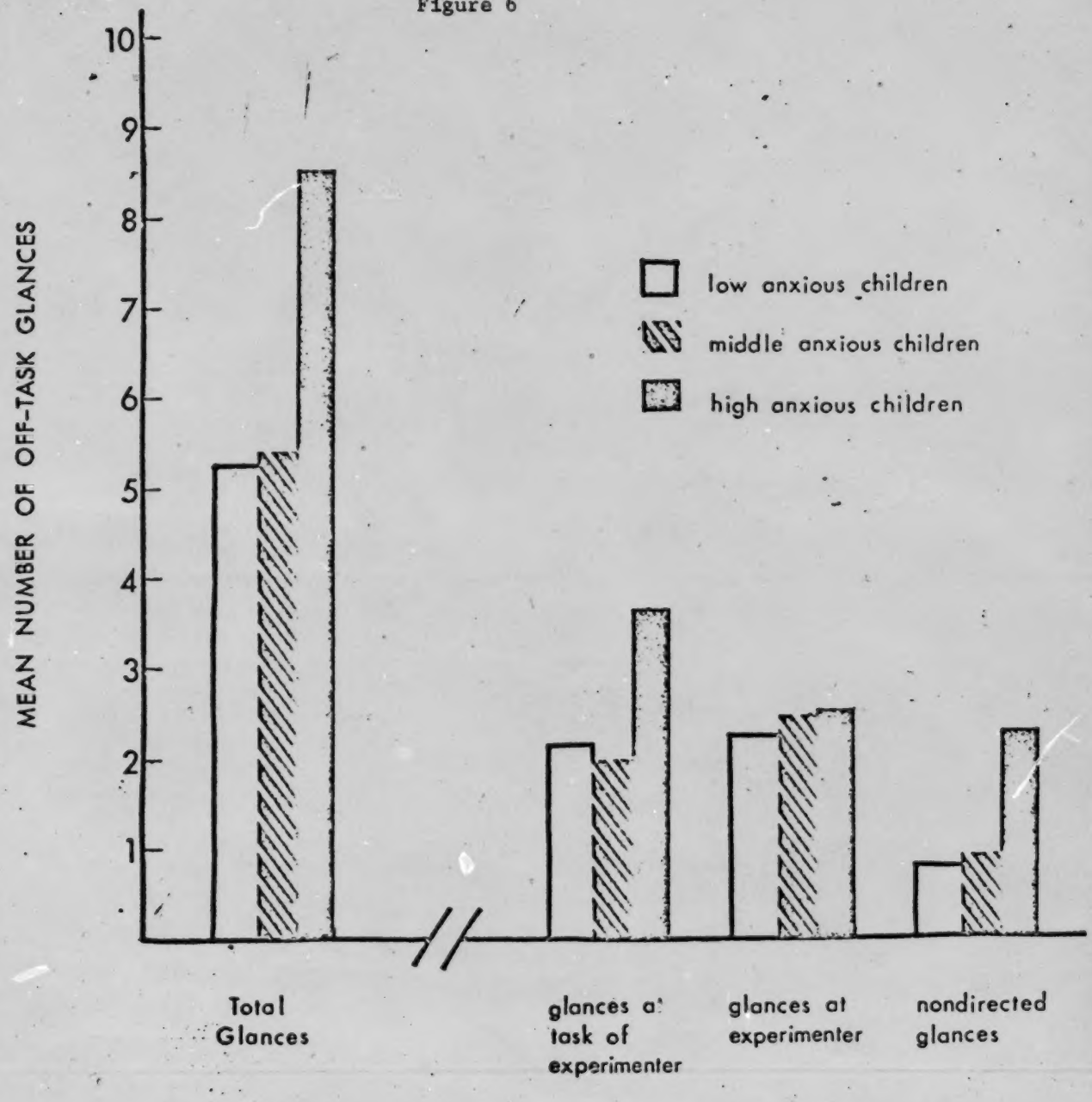



Figure 2

N.I.E. Project No. 2-0072

Appendice 2
Figure 7

NAME _____ BOY ____ GIRL____
First Last

Room No. _____ Date _____

A-Yes B-No 1. Do you worry when the teacher says that she is going to ask you questions to find how much you know?

A-Yes B-No 2. Do you worry about being promoted to the next grade at the end of the year?

A-Yes B-No 3. When the teacher asks you to get up in front of the class and read aloud, are you afraid that you are going to make some bad mistakes?

A-Yes B-No 4. When the teacher says that she is going to call upon some boys and girls in the class to do arithmetic problems, do you hope that she will call upon some one else and not on you?

A-Yes B-No 5. Do you sometimes dream at night that you are in school and cannot answer the teacher's questions?

A-Yes B-No 6. When the teacher says that she is going to find out how much you have learned, does your heart begin to beat faster?

A-Yes B-No 7. When the teacher is teaching you about arithmetic, do you feel that other children in the class understand her better than you?

A-Yes B-No 8. When you are in bed at night, do you sometimes worry about how you are going to do in class the next day?

A-Yes B-No 9. When the teacher asks you to write on the blackboard in front of the class, does the hand you write with sometimes shake a little?

A-Yes B-No 10. When the teacher is teaching you about reading, do you feel other children in the class understand her better than you?

A-Yes B-No 11. Do you think you worry more about school than other children?

A-Yes B-No 12. When you are out of school and you are thinking about your arithmetic lesson for the next day, do you become afraid that you will get answers wrong when the teacher calls upon you?

A-Yes B-No 13. If you are sick and miss school, do you worry that you will do more poorly in your schoolwork than other children when you return to school?

A-Yes B-No 14. Do you sometimes dream at night that other boys and girls in your class can do things you cannot do?

A-Yes B-No 15. When you are out of school and you are thinking about your reading lesson for the next day, do you worry that you will do poorly on the lesson?

A-Yes B-No 16. When the teacher says that she is going to find out how much yo have learned, do you get a funny feeling in your stomach?

A-Yes B-No 17. If you did very poorly when the teacher called on you, would you probably feel like crying even though you would try not to cry?

A-Yes B-No 18. Do you sometimes dream at night that the teacher is angry because you do not know your lessons?

In the following questions the word "test" is used. What I mean by "test" is any time the teacher asks you to do something to find out how much you know or how much you have learned. It could be by your writing on paper, or by your speaking aloud, or by your writing on the blackboard. A "test" is any time the teacher asks you to do something to find out how much you know.

A-Yes B-No 19. Are you afraid of school tests?

A-Yes B-No 20. Do you worry a lot before you take a test?

A-Yes B-No 21. Do you worry a lot while you are taking a test?

A-Yes B-No 22. After you have taken a test, do you worry about how well you did on the test?

A-Yes B-No 23. Do you sometimes dream at night that you did poorly on a test you had in school that day?

A-Yes B-No 24. When you are taking a test, does the hand you write with shake a little?

A-Yes B-No 25. When the teacher says that she is going to give the class a test, do you become afraid that you will do poorly?

A-yes B-No 26. When you are taking a hard test, do you forget some things you knew very well before you started taking the test?

A-Yes B-No 27. Do you wish a lot of times that you didn't worry so much about tests?

A-Yes B-No 28. When the teacher says that she is going to give the class a test, do you get a nervous or funny feeling?

A-Yes B-No 29. While you are taking a test, do you usually think you are doing poorly?

A-Yes B-No 30. While you are on your way to school, do you sometimes worry that the teacher may give the class a test?

NAME _____ BOY____ GIRL____
First Last

Room No. _____ Date _____

A-Yes B-No 31. Do you ever worry about knowing your lessons?

A-Yes B-No 32. Do you ever worry about what people think of you?

A-Yes B-No 33. Do you ever worry that you won't be able to do something that you want to do?

A-Yes B-No 34. When you were younger, were you ever scared of anything?

A-Yes B-No 35. Have you ever been afraid of getting hurt?

A-Yes B-No 36. Do you ever worry about something bad happening to someone that you know?

A-Yes B-No 37. Do you ever worry about what is going to happen?

A-Yes B-No 38. Are you ever unhappy?

A-Yes B-No 39. Has anyone ever been able to scare you?

A-Yes B-No 40. Have you ever had a scary dream?

A-Yes B-No 41. Do you ever worry?

# The Interaction of Test Anxiety and Success/Failure Experiences in Determining Children's Arithmetic Performance

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Running Head: Test Anxiety, Success/Failure, and Arithmetic Performance

Abstract

Effects of the motives to approach success and to avoid failure were studied in 60 fifth and sixth grade boys and girls of low, middle, and high levels of test anxiety. Children performed addition problems under one of two conditions: a mixed condition involving two-thirds success and one-third failure and a success only condition in which all problems attempted were completed. As predicted, high anxious children, when compared to less anxious children on response rate, off-task behavior, errors, and cheating, showed markedly inferior performance in the mixed condition, but comparable and improved performance in the success only condition. Different and unpredicted results were obtained for a measure of persistence. Findings indicate that anxious children perform poorly due to motivational difficulties rather than to learning deficiencies, and that their abilities are systematically underestimated by many achievement and educational testing procedures.

# The Interaction of Test Anxiety and Success/Failure Experiences in Determining Children's Arithmetic Performance

Ekehammar (1974) has recently argued that conceptions of personality "have converged and are converging toward an interactionist conceptualization," which views behavior as a function of both person and environmental variables. In a review of studies containing person X situation interaction terms, Bowers (1973) found that such interaction terms accounted for more behavioral variance than either situation or individual difference terms. The important question is not "how much" variance is accounted for by these nontrivial interaction terms, however, but rather "how" such interactions operate (Endler, Note 1). How person and situational variables interact in the domain of children's evaluation anxiety is addressed by Hill (1972). He has proposed a model which postulates different patterns of success/failure motives in children of differing anxiety levels. The model specifies quite different anxiety effects depending on which motives are salient in various success/failure situations, and consequently predicts an interaction between a child's self-report of anxiety and his experiencing of success and failure at problem-solving tasks.

Hill (1972) assumes that low anxious children, because of their general history of success in school and positive interactions with adults in evaluative settings, have strong motives to approach success and relatively weaker motives to avoid failure. High anxious children, on the other hand,

are known to have a history of frequent school failure (Hill & S. B. Sarason, 1966) and punitive interactions with adults in evaluative settings (Hermans, ter Laak & Maes, 1972; Ruebush, Byrum & Farnham, 1963; S. B. Sarason, Davidson, Lighthall, Waite & Ruebush, 1960). These negative experiences are assumed to strengthen both the high anxious child's motives to avoid failure and to gain success, but with the avoidance motive enhanced relatively more than the approach motive. Thus high anxious children are presumed to have both stronger approach and stronger avoidance motivation than low anxious children, with the motive to avoid failure predominating. Hill's model, then, attempts to specify the overall strength of both approach and avoidance tendencies for children at different anxiety levels as well as the relative strength of each tendency at a given anxiety level (see Atkinson & Feather, 1966; Atkinson & Raynor, 1974). Since school experiences are presumed to be a primary source of children's anxiety over being tested, an addition task, representative of arithmetic basic skill acquisition, was used in the present study to test hypotheses concerning the effects of success/failure motives. This choice of task contrasts with the game-like, non-intellectual tasks employed in much previous anxiety research with children (Hill, 1967; McCoy, 1965; see Ruebush, 1963).

Hill's (1972) model predicts quite different anxiety effects on performance depending on whether success, failure, or both of these motivational tendencies are operating strongly. A major purpose of the present study was to contrast the effects of children's motive to approach success operating by itself with those of both the motives to approach success and to avoid failure operating simultaneously. To

test for this contrast, low, middle, and high anxious children worked on arithmetic addition problems under one of two evaluative conditions, either in one involving success only or in one involving a mixture of success and failure.

In the condition involving a mixture of success and failure, children were able to complete only two-thirds of the problems they attempted. It was assumed that both the success motive and the failure motive would be operative and salient in this condition so that high anxious children would be strongly motivated to avoid failure and relatively less oriented toward achieving success. Low anxious children, in contrast, would be relatively more motivated toward achieving success than avoiding failure (Hill, 1972). In the mixed condition, then, high anxious children, in order to avoid failure, were expected to perform more slowly and cautiously and to show a tendency toward cheating as compared to less anxious children (see Shelton & J. P. Hill, 1969). Anxious children's strong failure motive was expected to cause them to avoid making mistakes by spending more time off-task (Nottelmann & Hill, Note 3) and by leaving the situation sooner. Furthermore, anxious children were expected to make more errors on the task because of their general tendency to perform poorly in evaluative situations (Hill, 1972; Spielberger, 1966). Low anxious children, in contrast, were expected to show the opposite effects due to their greater orientation toward achieving success, e.g. to perform more accurately and to cheat less.

The second evaluative condition involving success only was novel to the present study. All children in this condition were shown the arithmetic problems they were about to attempt, given several successful

practice trials, and given time to complete all of the problems they attempted, virtually assuring 100% success at the task. It was assumed that the failure motive would operate minimally, if at all, in this condition and that instead the success motive would predominate. High anxious children were expected to show better performance in this success only condition, which invoked their relatively strong motive to approach success, than in the mixed success/failure condition, which also invoked their even stronger motive to avoid failure. Thus, anxious children should perform faster, spend less time off-task, be more accurate, cheat less, and show greater persistence in the success only condition. Low anxious children, in contrast, should show similar performance in the two conditions since their dominant success motive would be functioning in both situations. The study thus tested a major implication of Hill's model--that the typical, expected superior performance of low anxious over high anxious children in the mixed success/failure condition should be lessened, and possibly reversed, in the success only condition.

## Method

### Subjects

Participants were drawn from a middle-class elementary school sample of 71 fifth and sixth grade children for whom parental permission for research participation had been obtained. As part of an ongoing program of school testing, the children had been administered the Test Anxiety Scale for Children (TASC) and the Lie Scale for Children (LSC) five months prior to the experiment. Six of the 71 children were excluded from the final sample because their high LSC score (6 or higher) cast

doubt on the validity of their typically low self-report of anxiety (see Hill & S. B. Sarason, 1966), three were excluded due to equipment failure, and two were not tested because design requirements had been met. Low, middle, and high test anxious groups of children were formed by partitioning the TASC distribution into thirds: the mean TASC scores for the low, middle, and high anxious subgroups were 1.79, 5.71, and 11.85, respectively. Within sex, children of a given anxiety level were randomly assigned to one of two treatment conditions, success only or mixed success/failure, resulting in a 3 (anxiety) X 2 (sex) X 2 (treatment) factorial design with 60 subjects.

Procedure

All participants were met in their classroom by the experimenter, a male in his mid-twenties, and accompanied to a research trailer parked adjacent to the school. Upon arrival at the testing room in the trailer, the experimenter seated the child at a small table with a pushbutton and a 10 cm high stack of half-sheets of paper and said:

> Ok, as you can see there is a stack of papers and a button here on the table. Each sheet of paper has one addition problem on it [the experimenter thumbed through the stack at this point]. Now, I'd like to have you work some of these problems, but first let me explain the button. It's hooked up to a bell which will ring to signal you to stop working on a problem if you haven't already finished it. So before taking each problem, you'll push the button and then take a sheet from the top of the stack and work it. When you finish the problem set it aside....If the bell rings before you finish a problem you must immediately stop, set the problem aside, and go on to the next problem.

The experimenter then had the child work five practice problems which were on top of the problem stack. After completing the practice problems, the experimenter continued:

> Now don't go back to work on a problem you've worked on, don't skip a problem, be sure to push the button before you start every problem, and as soon as the bell rings, be sure to stop and put the problem aside. Now we don't expect anyone to work all these problems or anywhere near all of them. Just work as many as you want to and come and get me in the next room when you're through.

The experimenter left the room and closed the door behind him. The child was allowed to work at the task up to a maximum of 45 minutes; only two of sixty children worked that long. After he stopped work on the problems and joined the experimenter in the waiting room, the child was asked some questions on how the problems might be improved and how age-appropriate they were. He was thanked and returned to his classroom.

An observer seated in a control room adjacent to the testing room of the trailer watched through a one-way glass and recorded the child's on- and off-task behavior with an Esterline-Angus event recorder. On-task behavior was defined as attention to a problem from the time at which the child wrote the first number of his answer to the time he put the problem aside. All other behavior was coded as off-task behavior. If a child interrupted his work midway through a problem, this break was coded as off-task behavior until attention was once again directed at the problem. The observer also noted any cheating behavior, which was defined as any violation of the experimenter's instructions not to work after the signal bell, skip ahead, or return to previously worked problems.

The observer operated the signal bell in the child's room by remote control. In the mixed condition he failed the child on one-third of the problems by sounding the bell before the child could complete each of those problems. Thus the failure procedure was adjusted to the individual child's work rate. To insure the credibility of the signal bell interruption, the failure problems were more complex and time consuming to solve, as explained in detail below. In the success only condition, in contrast, the observer never failed the child by operating the signal bell. Children in the success only condition completed all of the problems they attempted without interruption by the bell.

Problems

Half of the problems were matched across treatment condition to permit unambiguous comparisons of task performance. These problems, referred to as comparison problems, were all two-number problems with six digits per number and were identical for children in both conditions. The other half of the problems, the non-comparison problems, differed for success only and mixed success/failure participants. For the success only children, the non-comparison problems were similar to the comparison problems, i.e., they were two-number problems with six digits per number. For the mixed success/failure participants, however, the non-comparison problems were not two, but rather three-number problems, also with six digits per number. Furthermore, two-thirds of these three-number problems were relatively difficult because they required extensive carrying. These difficult, three-number problems, comprising two-thirds of non-comparison and one-third of all problems, were the problems interrupted by the observer-controlled failure bell. Children were allowed to complete the

remaining one-third of the non-comparison problems, the easy three-number problems, so that a problem having three numbers did not become a cue for certain failure. Thus, the participants in the mixed condition succeeded in completing two-thirds of the problems they attempted, and failed to complete one-third of their problems, the difficult three-number problems.

Analysis

Comparison problems, identical across treatment condition and uninterrupted by the signal bell, provided the basis for measures of rate, accuracy, and cheating. The rate at which a child worked was measured by the mean on-task time in seconds needed to complete comparison problems. Performance accuracy was measured by the percentage of comparison problems with an error in the answer. The percentage of problems on which a child worked after the bell, skipped a problem, or returned to a former problem was used as a measure of cheating behavior. Measures of off-task behavior and persistence were based on all problems attempted. The measure of mean time off-task per problem included time spent away from a problem during its solution as well as time spent between problems. The child's persistence at the task was indexed by the total number of problems he attempted before choosing to stop and rejoin the experimenter.

Since treatment condition was predicted to have differential effects on anxiety groups for all five variables, and since these variables were assumed to be interrelated, a multivariate analysis of variance (MANOVA) was employed in the analysis. The MANOVA included test anxiety, success/failure treatment condition, and sex of child as independent variables and the child's rate, time off task, accuracy, cheating, and persistence

as dependent variables. The major effect of interest was the two-way interaction of anxiety by treatment condition.

## Results

Examination of the correlations among the five dependent variables revealed that the four measures reflecting task performance, rate, off-task behavior, accuracy, and cheating were significantly ($p < .01$) and positively interrelated. The moderately strong intercorrelations among these four measures ranged from .53 to .76 except for the strong .93 correlation between mean time to complete a problem (rate) and mean time off-task per problem. Thus a child who completed problems quickly also spent little time off-task and tended to make fewer errors and to cheat less often than other children. Persistence, on the other hand, showed weak and non-significant ($p > .05$) correlations with the four performance measures ($r$ between -.07 and -.24). Thus the number of problems a child attempted was unrelated to how well he performed on the task.

The Hill model predicts a significant anxiety by treatment interaction in the pattern of scores for the five dependent variables, with differential performance favoring low anxious children in the mixed success/failure condition and improved and possibly superior performance by high anxious children in the success only condition. In the anxiety X treatment X sex MANOVA for rate, off-task behavior, accuracy, cheating, and persistence, the anxiety by treatment two-way interaction was found to be very significant, multivariate $F$ (10.88) = 2.46, $p < .02$. No other interactions or main order effects were significant. The means for the interaction of anxiety by treatment are presented for the four interrelated performance measures in Figure 1 and for the persistence measure

in Figure 2. To allow for meaningful comparisons across variables, the

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Insert Figure 1 about here

---

graphs in Figures 1 and 2 have been scaled so that the total height of the ordinate is equal to 1.5 standard deviations for each variable.

Inspection of Figure 1 reveals that in the mixed success/failure condition, high anxious children, as expected, showed inferior performance to low anxious children on all four performance measures, taking more time per problem, spending more time off-task, making more errors, and cheating more. In the success only condition, in contrast, performance differences between high and low anxious children were much smaller due to the predicted improvement in high anxious children's performance. Compared to performance of high anxious children in the mixed success/failure condition, high anxious children in the success only condition worked much faster, spent less time off task, made fewer errors, and cheated less. Low anxious children's performance improved slightly for subjects in the success only condition. Middle anxious children's performance was generally intermediate to that of low and high anxious children (see Figure 1).

Inspection of Figure 2, which depicts the results for the persistence measure, reveals a different and unpredicted pattern of means for the

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Insert Figure 2 about here

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anxiety by treatment interaction. High anxious children persisted longer

than low anxious children in both conditions, and both low and high anxious children attempted more problems in the mixed than in the success only condition. In contrast, the middle anxious children persisted less than low and high anxious children in the mixed condition but persisted more than these other children in the success only condition.

## Discussion

The results generally support Hill's (1972) model of motivational processes underlying effects of evaluation anxiety. The multivariate analysis revealed a highly significant interaction between the child's self-report of anxiety and his success/failure experience for the five dependent measures of rate, time off-task, accuracy, cheating, and persistence. With regard to specific predictions from Hill's model, results were clear-cut and as expected for the four performance measures but less consistent and not as predicted for the persistence measure.

Measures of children's persistence have not generally been emphasized in the anxiety research literature, which instead has focused on measures of performance (Gaudry & Spielberger, 1971; Hill, 1972; Ruebush, 1963). The persistence measure in the present study revealed that high anxious children attempted more problems than low anxious children in both conditions. In addition, both low and high anxious children attempted more problems in the mixed than the success only condition. Thus, high anxious children were most persistent in the mixed condition involving failure, where they were expected to leave the soonest. Middle anxious children, in contrast to low and high anxious children, showed the greatest persistence in the success only condition and the least persistence in the mixed condition, a reversal which is difficult to interpret.

The persistence findings for the low and high anxious children are particularly surprising given the interfering effects of anxiety on performance found for the mixed condition (see Figure 1); it appears clear that anxiety dynamics were invoked by this condition. Why, then, didn't high anxious children leave sooner? The lack of correlation between the persistence and performance measures suggests that different factors determined these two kinds of behaviors. While success and failure experiences resulted in the predicted differential anxiety effects for performance, an alternative explanation is needed for the persistence measure. One possibility is that children in the mixed condition and high anxious children in general, were concerned over later evaluation of their performance by the adult waiting in the next room (Hill, Note 2). These children may have been hesitant to leave the testing situation and instead persisted at the task to delay or avoid evaluation (see Hill, 1976). To minimize the possibility of such avoidance behavior, persistence could be studied using paradigms that do not require the child to return to a potentially evaluating adult after completing an academic task. For example, a non-academic alternate task could be made available for the child to turn to (Dweck & Gilliard, 1975; Reiss & Dyhdaldo, 1975), thereby reducing the effects of potential later adult evaluation on the child's persistence at the academic task.

Results for the four performance measures of rate, time off-task, accuracy, and cheating were exactly as predicted. Under mixed success and failure, high anxious children showed inferior performance to low anxious children, with the former taking almost twice as long per problem, spending almost twice as much time off-task, making three times as many errors, and

cheating twice as often. Under success only, however, high anxious children almost matched the performance of their low anxious counterparts (who themselves did slightly better), going almost as fast, spending as little time off-task, making just a few more errors, and cheating only somewhat more often. In general, performance of middle anxious children was intermediate to that of low and high anxious children. Thus the interfering effects of evaluation anxiety were dissipated in the success only condition, designed to minimize failure motives and to allow success motives to predominate.

It is noteworthy that high anxious children did almost as well as low anxious children in the success only condition for all four performance measures. If the anxious children had increased speed but at the expense of making more errors or had improved their accuracy but at the expense of maintaining a very slow rate, implications for achievement testing and classroom learning would be less striking. The fact that high anxious children both went as fast and were as accurate as less anxious children in the success only condition suggests that anxious children have the specific skills necessary to perform well on basic addition problems, although they fail to do so under testing conditions typical of those used in school. These results indicate that anxious children perform poorly on such tests due to motivational difficulties rather than to learning or ability deficiencies (see Hill, 1972; Zigler & Harter, 1969).

The present results are consistent with other recent studies showing that the performance "deficits" of children with histories of failure can be reversed by restructuring testing situations in ways that minimize debilitating motivational tendencies. The present study demonstrates that

high test anxious children can perform rapidly and accurately on problems involving basic addition skills when the threat of failure is removed and the child paces himself in the absence of time pressure. Williams and Hill (Note 4) have found that high test anxious elementary school children can perform accurately and fairly rapidly on age-appropriate achievement test arithmetic problems under adult evaluation and time pressure if the examiner indicates that a low proportion of successful solutions are expected, thus changing the child's criteria and expectations for success and failure. I. G. Sarason (1972) has found similar facilitating effects for examiner instructions to high test anxious college students. Zigler and his colleagues have also found facilitating effects for success/failure and adult approval/disapproval manipulations with low-income, disadvantaged children who typically show a history of failure in school (Zigler & Harter, 1969). Zigler and Butterfield (1968), for example, obtained higher IQ test scores for Head Start program children when using optimizing testing procedures, involving systematic addition of success experiences to failure experiences and supportive examiner comments, than when using standard conditions, involving a neutral examiner and frequent failure. In addition, Zigler, Abelson, and Seitz (1973) have found higher IQ scores for disadvantaged preschool children when testing following a "play" period with the examiner than when testing without such an experience.

All of these recent motivational studies involve problem-solving tasks similar to those children perform in school or on standard intelligence and achievement tests. These findings together with the present results indicate that interactions between motivational dispositions and situational determinants are highly relevant to children's performance in educational

testing situations. Moreover, the research suggests that such highly evaluative testing procedures systematically underestimate the abilities and achievement of many anxious children with histories of failure in school (Hill & S. B. Sarason, 1966). Further research on optimizing testing procedures should facilitate the development of basic theories of the interaction between children's achievement-related motives and situational variables as well as lead to less biased and more useful testing procedures for educational practice.

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## Figure Captions

Figure 1. Performance means as a function of test anxiety and success/failure experience. Different subjects determine each point.

Figure 2. Task persistence as a function of test anxiety and success/failure experience. Different subjects determine each point.

Figure 1

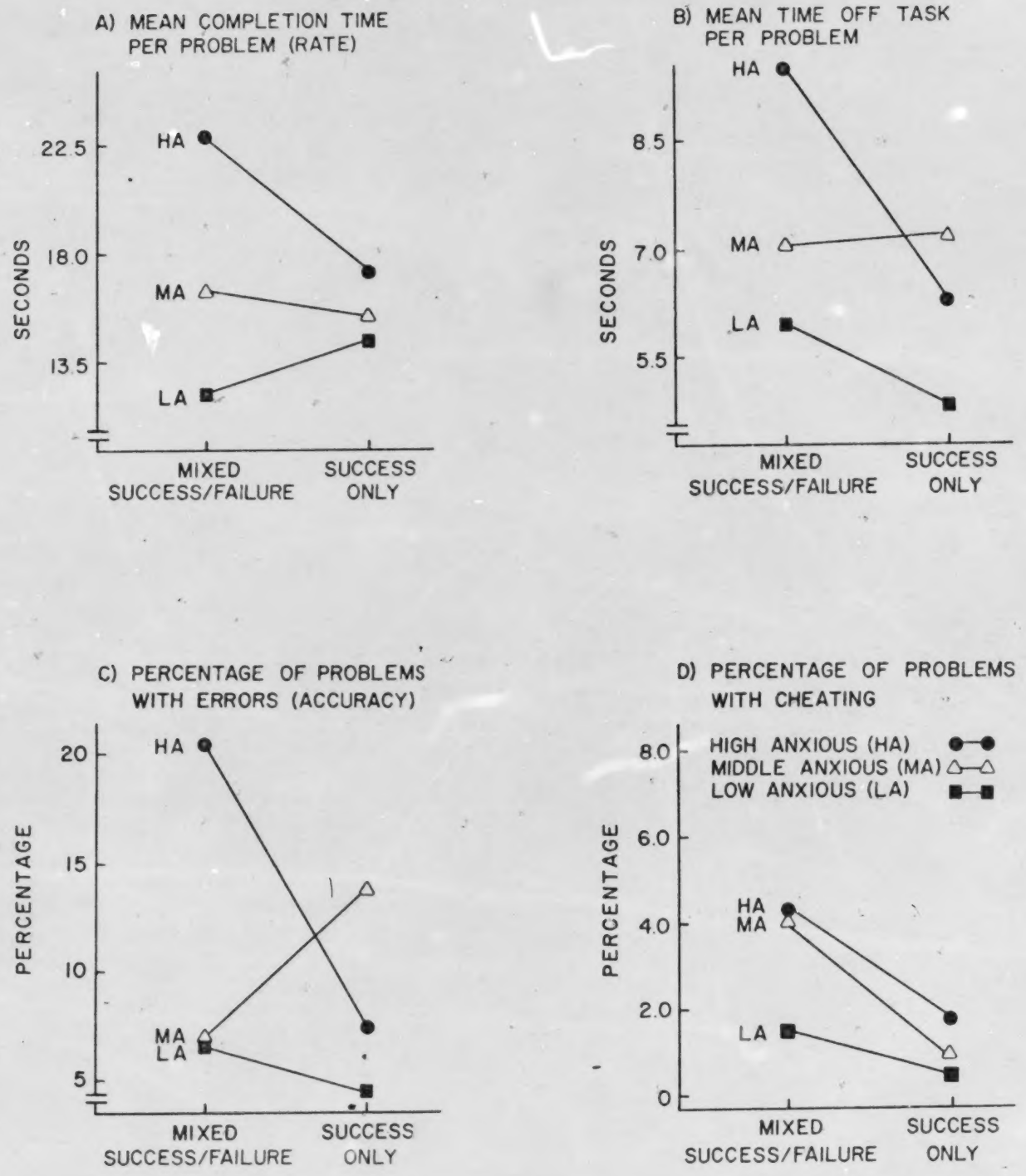
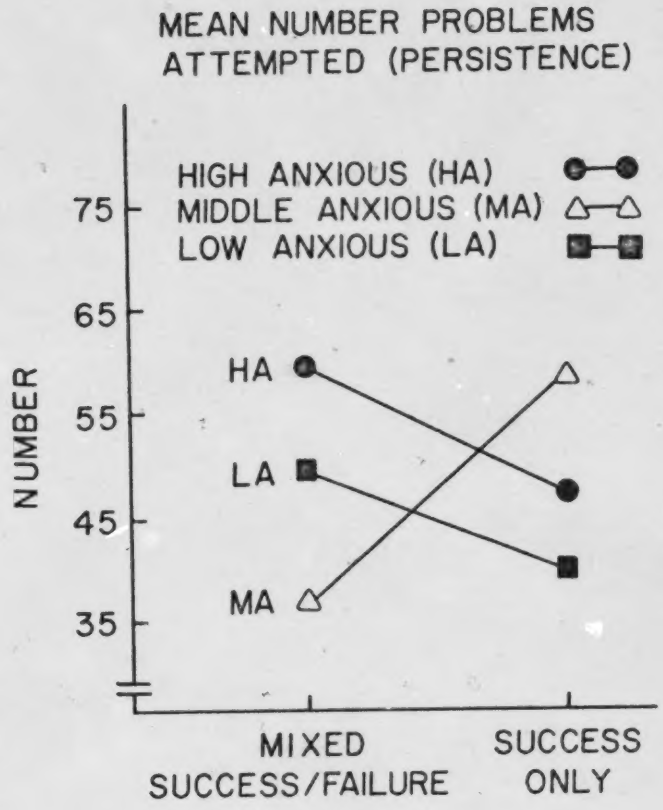

A) MEAN COMPLETION TIME PER PROBLEM (RATE)
SECONDS
22.5
18.0
13.5
HA
MA
LA
MIXED SUCCESS/FAILURE
SUCCESS ONLY
B) MEAN TIME OFF TASK PER PROBLEM
SECONDS
8.5
7.0
5.5
HA
MA
LA
MIXED SUCCESS/FAILURE
SUCCESS ONLY
C) PERCENTAGE OF PROBLEMS WITH ERRORS (ACCURACY)
PERCENTAGE
20
15
10
5
HA
MA
LA
MIXED SUCCESS/FAILURE
SUCCESS ONLY
D) PERCENTAGE OF PROBLEMS WITH CHEATING
HIGH ANXIOUS (HA)
MIDDLE ANXIOUS (MA)
LOW ANXIOUS (LA)
PERCENTAGE
8.0
6.0
4.0
2.0
0
HA
MA
LA
MIXED SUCCESS/FAILURE
SUCCESS ONLY

Figure 2


MEAN NUMBER PROBLEMS
ATTEMPTED (PERSISTENCE)
HIGH ANXIOUS (HA)
MIDDLE ANXIOUS (MA)
LOW ANXIOUS (LA)
NUMBER
75
65
55
45
35
HA
LA
MA
MIXED
SUCCESS/FAILURE
SUCCESS
ONLY

# Performance on Achievement Test Problems as a Function of Optimizing Test Presentation Instructions and Test Anxiety

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Running head: Optimizing Test Instructions and Anxiety

## Abstract

The effect of different test presentation instructions on the performance of 144 fourth and fifth grade boys and girls from regular and advanced math classes and low, middle, and high levels of test anxiety was investigated. Children performed at computation and arithmetic word problem achievement test items under one of four test presentations which differed in terms of (a) the extent to which the attainment of objective success was possible and (b) the extent to which failure and disapproval could be avoided. Anxious children from advanced and regular math classes showed different strategies at the tasks. As predicted, high test anxious children, expecially those in regular math classes, performed better in conditions in which the threat of failure and disapproval was minimized than in highly evaluative conditions. Low and middle anxious groups, however, showed a tendency to perform somewhat better in the more evaluative conditions. Implications of these data for testing procedures designed to further optimize the performance of anxious children were discussed.

Performance on Achievement Test Problems as a Function of Optimizing Test Presentation Instructions and Test Anxiety

Many studies with both children and adults have demonstrated a negative relationship between test anxiety and performance on intelligence and achievement tests and complex learning measures (I. G. Sarason, 1963; S. B. Sarason, Hill & Zimbardo, 1964; Spielberger, 1966; Stevenson & Odom, 1965). Test anxiety has typically been found to be a debilitating factor in performance (Ruebush, 1963) which may result in the underestimation of the ability of highly test anxious persons on standardized tests (Mander & Sarason, 1952).

The experimental manipulation of test anxiety through information or instructions given prior and the subsequent effect upon test performance has been studied with adults by several investigators (I. G. Sarason, 1972). Generally, the evidence indicates that level of test anxiety interacts with the degree of evaluative emphasis contained in the pretest information, such that low test anxious adults do better under highly evaluative conditions, while high test anxious subjects do better under conditions in which the evaluative aspects of the testing are minimized, e.g., when the task is presented as being used for normative purposes only, unrelated to the ability of the subject, or as being generally unimportant (Paul & Erikson, 1964; S. B. Sarason, Mandler, & Craighill, 1952).

Several studies have indicated that to obtain optimal performance from high test anxious adults it may not always be necessary to remove the evaluative emphasis of the test entirely. In several studies of serial verbal learning, I. G. Sarason (1958, 1972) has found that by

using a "reassurance" instruction, high anxious adults were able to perform better in conditions where neutral, or achievement-orienting instructions were presented. The reassurance instruction indicated to the subjects that although errors would be made, it was not necessary to become unduly upset over mistakes. Low anxious subjects performed better in the evaluative, achievement-orienting instructions, which stressed the assessment of the ability of the subjects, than in the reassurance condition.

The experimental evidence for the interaction of test anxiety and instructional set with children has been rather limited. It has been found that when the task presented is game-like or requires cautious responding, which may be characteristic of high anxious individuals, high anxious children can often do better than low anxious children (McCoy, 1965; Ruebush, 1960; S. B. Sarason, Davidson, Lighthall, Waite, & Ruebush, 1960). However, these paradigms bear little resemblance to the kinds of tasks required to demonstrate academic achievement in school. Sarason et. al., (1960) have indicated that it is precisely the similarity of achievement and intelligence tests to classroom tasks which arouses test anxiety. The present study tested hypotheses as to the type of instructions or test presentations which would optimize the performance of children of varying anxiety levels on highly evaluative arithmetic tasks comparable to standard achievement tests and representative of children's school learning activities.

Hill (1972) has conceptualized the high anxious child as one whose motive to avoid failure and disapproval is predominant, while the low anxious child shows a greater motive to approach success and approval.

It is presumed that both motives are stronger in absolute level for high anxious than for low anxious children. It is suggested that the high test anxious child may rely more on adults for the assessment of performance, while the low anxious child may rely more on task-inherent feedback coming from performance and on his own internal self-evaluation. Thus the effect of any particular test presentation upon the performance of high and low anxious children is determined by (a) the extent to which the low anxious child can approach objective success, and (b) the extent to which the high anxious child can avoid failure and disapproval.

Four types of test presentations were developed for this study. One presentation indicated that the situation was evaluative, that it was in fact a test of ability. This was called the standard test presentation, typical of many current achievement tests. In the diagnostic presentation, the situation was still test-like, but the purpose of the test and the use to which it would be put was construed in terms of its benefit to the child. The third test presentation was designed to indicate that the child could expect failure, but that failure was experienced by everyone and that he should not worry about it (see I. G. Sarason, 1972). This presentation was termed the expectancy-reassurance condition. The fourth test presentation, the normative condition, was seen as being qualitatively different from the other three conditions by the removal of adult evaluation and possible approval/disapproval. In this condition, the examiner indicated that he was only interested in group performance, and that children should not even write their name on the answer booklet.

For the low anxious children, the standard presentation of the test was expected to provoke strong arousal of the motive to obtain success,

resulting in optimal performance in this condition. The diagnostic test presentation still allowed for the opportunity to perform successfully, but the incentive value for doing so was thought to be mitigated by the absence of personal evaluation. The expectancy-reassurance presentation was expected to lower the motivation and performance of low anxious children further because the probability of success was indicated as being rather low. The normative test presentation was expected to have the most deleterious effect upon the performance of the low anxious child, since the possibility of personal success and approval was completely eliminated in this condition.

It was expected that the high anxious child would perform worst under the standard test presentation. This condition, in which the evaluation of ability was stressed, was designed to most strongly arouse the motives to avoid failure and disapproval, motives which have a deleterious effect on the performance of high anxious children. In the diagnostic condition, some of the stressful aspects of the test-taking situation were reduced through the implication that the results of the test would be used to help the child, but anxiety should still be operative since the standards for good performance were ambiguous and an assessment of the child's competence was clearly indicated. The expectancy-reassurance presentation was designed to allow the high anxious child to show substantially better performance than in the standard condition since the adult indicated that fairly frequent failure was acceptable. Thus the level of performance defined as successful and satisfactory by the experimenter was lower than the child typically interprets in evaluative situations. The child's motives to avoid failure and disapproval would be lessened since he could

now expect to receive approval for a far less than perfect performance. Finally, the high anxious child was expected to show better performance in the normative, compared to the standard condition. The elimination of possible evaluation by the adult was expected to cause the motives to avoid disapproval and approach approval to operate minimally, if at all. The removal of these motives should weaken the effects of success/failure motives and lessen the relative dominance of the failure motive for high anxious children.

This study also included a group of subjects who showed a middle level of test anxiety. According to Hill's (1972) formulation, these persons should have moderate and approximately equal motives to approach approval and success and to avoid disapproval and failure. Previous research has indicated that middle anxious subjects might be expected to perform at an intermediate level of accuracy but more like low than high anxious subjects under the various test presentations (Hill & Sarason, 1966; I. G. Sarason, 1972).

## Method

### Subjects

The subjects were white, middle class fourth and fifth graders from two elementary schools in Danville, Illinois who had received parental permission to participate in the study. The children at each school and at each grade level had been assigned by the school staff into advanced and regular math classes. A sample of 157 subjects was available for the personality testing sessions. There were 48 fourth and 37 fifth grade boys and 33 fourth and 39 fifth grade girls.

Materials

Personality Measures. The subjects were given the Test Anxiety Scale for Children (TASC) and the Lie Scale for Children (LSC) at least one week before they participated in the experimental testing (S. B. Sarason et al., 1960; S. B. Sarason, Hill and Zimbardo, 1964). The subjects were tested in their usual classroom groups by either a male or female graduate student who thereafter did not participate in any additional testing. The expected negative relationship between TASC and LSC scores was significant for boys ($r = -.47$, $p < .001$) and girls ($r = -.36$, $p < .01$). Subjects with high LSC scores (7 or above) were not included in the major analyses due to the questionable validity of the TASC scores of such children (Hill and Sarason, 1966). The remaining 144 children were divided into low, middle, and high anxious groups based on their TASC scores; the mean TASC scores for these groups were 5.2, 11.9, and 19.2 respectively.

Arithmetic Tests. Two arithmetic test booklets were constructed from items appearing on the Bobbs-Merrill Achievement Test (Levels 4 to 6), the California Achievement Test (Level 3) and the Stanford Achievement Test (Intermediate II). One test booklet was comprised of 45 word problems. The other booklet contained 24 computation problems. The computation problems were judged to be easier to solve than the word problems, and so provided the opportunity for the subjects to experience at least some success in the testing situation. Each problem appeared on a separate page, with ample space provided for working out the computations. There were four alternative answers given for each problem, and the correct answer was always among the alternatives. Each test booklet began with easy items in order to be congruent with the form of a standardized

achievement test. Item difficulty thereafter was random to control for item order effects (e.g., Munz & Smouse, 1968) which were not of interest in this study.

Procedure

The children were escorted from their classrooms in groups of three or four by the senior author. Small group, rather than individual testing, was done, in order to avoid one-to-one involvement between the experimenter and the child while still allowing for close experimenter monitoring of the session. As far as possible, each group contained at least one subject from each of the three levels of anxiety. Children were seated in full view of the experimenter but with screens separating each child's work space, so that subjects could not see each other's work.

After the children were seated, the experimenter passed out the booklets of word problems and told the subjects (except for those in the normative condition) to write their name and grade on the front of the test booklet. The experimenter explained the procedure for answering the problems on the arithmetic tests and indicated that there was a time limit on working the problems.

After these introductory remarks, the group of subjects was given one of the four test presentations for the word problems, which were later repeated for the computation problems. These were:

1. Standard--"This is a test of your ability to solve arithmetic problems. We want to see how good you are at doing math."

2. Diagnostic--"This is a test of your ability to solve arithmetic problems. We want to see how you are coming along in math. We want to find out which things you know well, and which things you can't do. This

way we can find out what things you need more work on in math. Then we can work on those things."

3. Expectancy-reassurance--"This is a test of your ability to solve arithmetic problems. Some of these problems will be very hard and some will be easy. No one gets all these problems right. In fact, most children get quite a few wrong, so don't worry when you can't do some of the problems."

4. Normative--"This is a test of children's ability to solve arithmetic problems. We are not interested in how each individual child does so you don't even have to put your name on this test. What we want to know is how all fourth (fifth) graders go about solving these problems and how interesting they think it is to do these problems."

The subjects were then told to begin work on the problems. As on typical achievement tests, each section of the experimental task had a time limit. Subjects were given 20 minutes to do the word problems and 10 minutes to complete the computation problems. Most children were unable to finish either section. Only 10% finished the word problems and 17% finished the computation problems. After the testing the experimenter reassured all children that they had done well.

## Design

A 4 (Test presentation: standard, diagnostic, expectancy-reassurance and normative) by 3 (Anxiety: low, middle, and high) by 2 (sex of subject) by 2 (math class: advanced and regular) factorial design was used. The factor of math class was included in the design in light of previous research revealing stronger effects of test anxiety for children showing poor achievement test and school performance than for those showing

average or better performance (Sarason et al., 1960; Ruebush, 1963). An unweighted means analysis of variance was computed due to the unequal cell size, which varied from two to five subjects per cell. This analysis was selected in order to incorporate the maximum number of available subjects into the design. Each cell was balanced as closely as possible for grade level.

## Results

Analyses were done separately for computation and word problems. The four dependent measures used were: proportion correct of the problems attempted, average time per problem, number of problems attempted, and number of problems correct. Comparison of the pattern of results obtained from these four measures was expected to aid in the clarification and interpretation of the effects of particular test presentations upon the performance of high, middle, and low anxious children. Both proportion correct and absolute number correct may be considered indices of the overall excellence of performance. However, these measures do not show a direct relationship to one another, since they are differentially effected by the type of strategy employed in approaching the problems.

The measures of average time per problem and number of problems attempted were thought to reflect the general problem-solving approach used by children in the various conditions. There was a strong negative correlation between these two measures across groups ($\underline{M} = -.95$ for both tasks). Since most children didn't finish in the time limits allowed, spending more time per problem resulted in fewer problems tried. A subject's accuracy and rate/number attempted jointly determined his total number of correct solutions. For example, some groups showed fairly slow and highly accurate performance but had fewer total correct than other groups that went substantially faster with only a small loss of accuracy.

The major hypotheses of the study were concerned with the interaction of test presentation with anxiety. The data revealed that quite often the performance of different anxiety groups in the test presentation conditions interacted with the child's math class membership. In order to facilitate comparisons among the four dependent measures for the two tasks, then, presentation of results is organized around these major two- and three-way interactions, followed by a summary of other findings. Trends from non-significant interaction effects are briefly summarized where they help clarify significant findings for the proportion correct and other dependent measures (see Williams, 1976, for details). Generally, the predictions of this study were most strongly supported for high anxious subjects, especially those in the regular math class. Although high anxious subjects in both advanced and regular math classes responded to the test presentations, the strategies used and the quality of performance of these two groups were quite different.

Interaction of Test Presentation with Anxiety

A significant two-way interaction of Test Presentation X Anxiety was found in the analysis of proportion correct for computation problems, $F$ (6, 96) = 2.46, $p < .05$, but not for word problems, $F$ (6, 96) = 1.03). The significant interaction for the computation problems supported the predictions of the study. As can be seen in Figure 1, high anxious subjects showed increasing accuracy going from standard to diagnostic to expectancy-reassurance conditions, and greatest accuracy of all 12 groups in the normative condition. The Duncan's New Multiple Range (NMR) test revealed that high anxious children in the normative condition were significantly more accurate, $df = 96$, $p < .05$, than those in the standard

and diagnostic conditions. Conversely, although the differences were not significant, low and middle anxious subjects did better in the standard and diagnostic conditions than in either the expectancy-reassurance or the normative condition, resulting in the significant cross-over interaction. In the normative condition in which adult evaluation was lacking, high anxious children were significantly more accurate than either low or middle anxious children (Duncan's NMR, $df = 96$, $p < .05$).

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Insert Figure 1 about here

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Although the interaction of test presentation with anxiety was not significant in the analyses of average time per problem, number of problems attempted and number of problems correct for the computation problems (all $F$'s $\leq$ 1.25), inspection of trends in these data help clarify the significant effects for performance accuracy reported in Figure 1. For example, the high anxious subjects in the normative condition, who showed the greatest accuracy of all 12 groups, also took longer per problem ($M$ = 58.2 seconds) than any other group ($M$ range, 35.7 to 50.1 seconds). These results suggest that high anxious children in the normative condition improved their performance accuracy by slowing down, taking more time at the task, and thus trying fewer problems than any other group and having a smaller number of problems correct than in 9 of the 11 other groups.

High anxious children in the expectancy-reassurance condition showed a different pattern of results. These children, while showing a 10% greater accuracy than high anxious children in the standard condition

(see Figure 1), showed no decrement in response rate, and actually took less time in the expectancy-reassurance conditions ($M$ = 39.0 seconds) than the standard condition ($M$ = 48.4 seconds). High anxious subjects, then, were both more accurate and tried a few more problems in the expectancy-reassurance than the standard condition and thus had a somewhat greater total number correct in the expectancy-reassurance ($M$ = 12.5) than the standard condition ($M$ = 9.3).

Interaction of Test Presentation, Anxiety, and Math Class

The three-way interaction of test presentation, anxiety, and math class was significant for three of the four dependent measures for the word problems and two of the four measures for the computations problems. Results for the word problems will be presented first followed by those for the computation problems.

Word Problems. The means in the significant three-way interaction of Test Presentation X Anxiety X Math Class, $F$ (6, 96) = 2.26, $p < .05$, for proportion correct for the word problems are presented in Table 1. As can be seen, performance accuracy of the different anxiety groups was

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Insert Table 1 about here

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exactly as predicted for children in the regular math class. In the standard condition, high anxious children were significantly less accurate than either low or middle anxious subjects, Duncan's NMR, $df$ = 96, $p < .05$ (Table 1). Across conditions, high anxious children showed significantly greater accuracy ($M$ = 69%) in the expectancy-reassurance condition compared to the standard ($M$ = 38%) condition (Duncan's NMR, $df$ = 96, $p < .05$). Performance accuracy was somewhat improved for high anxious

children in the normative compared to the standard condition. As can be seen in Table 1, low and middle anxious children showed small decreases in accuracy between the standard and the other three test presentation conditions.

For children in the advanced math classes, performance was generally quite accurate (see Table 1). High anxious advanced math children were significantly more accurate in the standard condition ($M$ = 79%) than the regular math class, high anxious subjects in this condition ($M$ = 38%), Duncan's NMR, $df$ = 96, $p < .05$. High anxious advanced math subjects performed about as accurately as advanced math middle anxious and low anxious children in this condition. High anxious advanced math children did show some drop in accuracy in the expectancy-reassurance condition compared to the standard condition.

The three-way interaction of test presentation, anxiety and math class was also significant for mean time per problem, $F$ (6, 96) = 2.21, $p < .05$, and means bearing on this interaction are presented in Table 2.

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Insert Table 2 about here

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The amount of time spent on each problem by different groups of children, in combination with the measure of proportion correct, suggested different strategies of performance at the task and also clarified the effects of conditions on subjects' total number of correct solutions. For example, advanced math high anxious children showed much faster performance in the expectancy-reassurance condition ($M$ = 33.6 seconds per problems) for which performance on proportion correct had decreased only somewhat ($M$ = 69%)

compared to the standard condition ($\underline{M}$ = 50.3 seconds per problems, $\underline{M}$ = 79%). This suggests that high anxious advanced math students were unnecessarily cautious in the standard condition. The expectancy-reassurance condition appeared to free these subjects to perform quickly as well as accurately. Although the three-way interaction was not significant for total correct solutions ($F < 1$), inspection of the data revealed that advanced math, high anxious children had more correct solutions in the expectancy-reassurance condition ($\underline{M}$ = 25.8) than in the standard condition ($\underline{M}$ = 20.8). In summary, high anxious advanced math subjects performed slowly, but accurately in the standard condition and improved their performance in the expectancy-reassurance condition by performing much more quickly but with very little loss in accuracy.

A different pattern of findings was obtained for regular math, high anxious children in the standard and expectancy-reassurance conditions. In the standard condition, these high anxious, regular math subjects, who had shown very poor performance accuracy (Table 1), showed a tendency, although not significant, to take less time per problem than high anxious children in the expectancy-reassurance condition, in which performance accuracy was significantly higher. These results suggest that the regular math, high anxious children performed quickly but inaccurately in the standard condition, and the effects of the expectancy-reassurance conditions was to slow them down and increase accuracy, much like the strategy of low and middle anxious children in regular math in the standard condition. The result of the high anxious, regular math subjects working more slowly on the problems, but performing significantly more accurately was to increase their total number of correct problems done for this group in

the expectancy-reassurance ($M$ = 17.4) compared to the standard condition ($M$ = 12.5). In summary, the high anxious children from regular math classes worked quickly through the problems, but showed very poor accuracy in the standard condition and improved their performance in the expectancy reassurance condition by working somewhat more slowly, but much more accurately.

The other major finding in the analysis of time per word problem is the striking finding that high anxious, regular math subjects in the normative condition take about twice as much time per problem than other groups in the study (see Table 2). This extreme group differed significantly from all 23 other groups, Duncan's NMR, $df$ = 96, $p < .05$).

The significant three-way interaction for the number of word problems attempted, $F$ (6, 96) = 2.29, $p < .05$, revealed that these regular math, high anxious children in the normative conditions tried the fewest number of problems ($M$ = 21.8) of any group, although this finding was not significant. As would then be expected, this group had the fewest correct solutions ($M$ = 8.8) of any group in the study, because they spent a very long time on each problem and were relatively low in performance accuracy.

Computation Problems. The three way interaction of Test Presentation X Anxiety X Math Class ($F$ (6, 96) was significant for average time per problem ($F$ = 3.35, $p < .01$) and number of problems attempted ($F$ = 3.19, $p < .01$) but not for proportion correct ($F < 1$) or number correct ($F$ = 1.36) for computation problems. For this task, the high anxious regular math subjects in the normative conditions took significantly more time per problem ($M$ = 80.4 seconds) than any of the other 23 groups ($M$ = 31.5 to 58.9 seconds), Duncan's NMR, $df$ = 96, $p < .05$. This extreme group again

tried significantly fewer problems ($M$ = 8.3) than most other groups ($M$ = 12.5 to 20.2), Duncan's NMR, $df$ = 96, $p < .05$. Although not significant, the regular math high anxious subjects in the normative condition had the fewest number of correct problems ($M$ = 6.8) than all but one of the other 23 groups in the triple interaction. Again, their very slow rate of problem solving more than offset their high degree of accuracy shown in this condition.

For computation problems, the pattern of results for accuracy and time per problem for subjects in the standard and expectancy-reassurance conditions were similar to those found for word problems. On the computation problems, the high anxious children from the regular math class showed the lowest performance accuracy ($M$ = 58%) in the standard condition but did not differ significantly from other groups as had been found for the word problems. On the other hand, the tendency for high anxious children in the advanced math class to take more time in the standard condition ($M$ = 58.4 seconds) than other groups but less time in the expectancy-reassurance condition ($M$ = 32.5 seconds) was a significant effect for the computation problem data (Duncan's NMR, $df$ = 96, $p < .05$). Moreover, advanced math, high anxious children showed no loss of accuracy in the expectancy-reassurance ($M$ = 79%) compared to the standard ($M$ = 72%) condition.

Additional Findings

There were several additional findings in the unweighted means analyses involving main effects of math class and sex of subject (see Williams, 1976 for details). There was also a significant ($p < .01$) main effect for test anxiety in the analysis of proportion correct for the word problems (see

Table 1). Finally, in the analysis of proportion correct for the computation problems, there were significant interactions between sex and test presentation ($p < .05$) and sex and test anxiety ($p < .05$), interactions that failed to occur in any other analyses and did not interact with or clarify the major results of the study.

## Discussion

Results for interactions involving test presentation, test anxiety, and math class supported several of the hypotheses derived from the Hill (1972) model of test anxiety and revealed several unexpected findings. Most of the major significant results were obtained in the analyses of proportion correct for both computations and word problems. In general, high anxious children were more strongly effected by the test presentations than low and middle anxious children, similar to findings with adults ( I. G. Sarason, 1972). The accuracy and rate (time per problem) data taken together suggested quite different facilitating effects for the advanced versus regular math class anxious children on the word problems task, and for the expectancy-reassurance versus normative conditions in general.

The differential effects of the test presentations on high anxious subjects in the advanced and regular math classes is most clearly shown in the significant three-way interaction for proportion correct for the word problems (Table 1). Results were strong and exactly as predicted for the regular math class children who presumably have a greater history of failure than advanced math class children. The failure and disapproval motives believed to underlie the effects of high anxiety in the Hill model should operate most strongly for regular math children. Regular math class high anxious children showed markedly and significantly lower

accuracy (38%) than low and middle anxious children in the standard condition while tending to spend less time per problem. The expectancy-reassurance condition facilitated performance of these anxious children by encouraging them to slow down somewhat and show significantly greater accuracy (69%), with a resulting trend of improving by about five more problems correct between the standard and the expectancy-reassurance condition, from 12 to 17. High anxious children in the expectancy-reassurance condition thus performed much like less anxious children in the standard condition representative of typical achievement test procedures.

A different pattern of results emerged for high anxious children in the advanced math classes. These anxious children showed significantly greater accuracy in the standard condition (79%) than their high anxious counterparts from regular math classes. But while being as accurate as low and middle anxious advanced math children in the standard condition, high anxious advanced math children took a good deal more time per problem (Table 2) and hence tended to obtain fewer correct colutions. The expectancy-reassurance condition facilitated performance of these anxious children by enhancing their performance rate, a significant change for the computation problems, with little or no loss in accuracy. Again, these advanced math anxious children improved by about five more word problems correct between the standard and the expectancy-reassurance condition, from 21 to 26.

The data for computation problems also showed evidence of the consistent but different approaches of regular and advanced math high anxious subjects to problem-solving situations. The significant triple interaction of average time per computation problem revealed that high

anxious, advanced math students spent a significantly longer time in working each problem in the standard than in the expectancy-reassurance condition. Though not significant, the opposite trend of the regular math, high anxious counterparts to work more quickly in the standard than expectancy-reassurance condition was also seen. With regard to performance accuracy, analyses for the computations problems revealed a significant two-way interaction of test presentation and anxiety. These factors did not interact with math class in a three-way interaction, however, as both advanced and regular math high anxious subjects showed greater accuracy in the expectancy-reassurance than in the standard condition.

The findings lead to a refinement in the general conclusion that high anxious children are cautious in problem solving situations (Ruebush, 1963; Hill, 1972). Cautious strategies often have been studied for non-intellectual, game-like tasks (e.g., Ruebush, 1960; McCoy, 1965). The present results suggest that in highly evaluative academic situations, high anxious children with a history of failure such as those in the regular math classes perform rapidly and inaccurately at the task, a maladaptive avoidance strategy perhaps intended to terminate a threatening, unpleasant situation as soon as possible. In contrast, it was the high anxious children from the advanced math classes with a greater history of success that showed an unnecessarily slow and cautious approach to problem solving in the highly evaluative standard condition representative of most achievement and school tests. As in previous reasearch, anxiety was less debilitating for these high anxious, high-achieving children even in the standard condition than for the high anxious, low-achieving children (Feldhusen & Klausmeier, 1962; Paul & Eriksen, 1964; Ruebush, 1960).

The normative condition was conceptualized as being qualitatively different from the other three test presentations since the possibility of adult evaluation was virtually eliminated. The removal of possible approval/disapproval was expected to weaken the effects of success/failure motives and the debilitating effects of the motive to avoid failure for the anxious child. The significant triple interaction of test presentation, anxiety, and math class for both time per problem and number of problems attempted for both the word and computation problems indicated that regular math class, high anxious children performed quite differently in the normative than the other three conditions. These children took almost twice as much time per problem and tried many fewer problems than any other group, often showing significantly different performance than all other groups. The same three-way interaction for the accuracy measure for word problems and the two-way interaction of test presentation by anxiety for computation problems revealed that anxious children sometimes showed greater accuracy in the normative condition and sometimes did not, but in all cases had very few total correct solutions because of their very long time per problem. It appears that the high anxious children, expecially those from the regular math classes with a history of failure, showed less involvement with the task than other groups. The removal of possible adult evaluation may have resulted in greater off-task behavior and inattentive problem solving behavior that has been found to be associated with anxiety (Nottelmann & Hill, 1975; Phillips, Martin & Meyers, 1972; Wine, 1971). Low anxious children in general and high anxious children with a history of success, in contrast, appear less concerned with adult reactions and more concerned with succeeding at what they are

doing (Atkinson & Feather, 1966; Cox 1968; Hill, 1972; Weiner & Kukla, 1970), so that performance efforts maintain in the normative condition.

In contrast to earlier findings with adults (I. G. Sarason, 1972), the diagnostic test presentation failed to reveal any significant differences from the standard condition, although many of the means for the several anxiety groups were in the predicted direction. It appears that telling the children that information as to how well they were doing at the task would be used to help them in math was either a discrimination too difficult for them to make or perhaps a promise too difficult for them to accept without more experience with the adult and procedure. In contrast, I. G. Sarason (1972) found that adults both attend to the subtle distinctions in this kind of test presentation and respond strongly to their meaning and implications.

The improved performance, in terms of proportion correct, of high anxious subjects in the expectancy-reassurance condition compared to the standard and diagnostic conditions indicates that such high anxious children may have more ability than they typically demonstrate in achievement test situations. The results suggest that in testing situations where power is assessed independently of speed of performance, high anxious subjects with a history of failure may optimize their performance when fear of failure or disapproval is reduced by performing accurately but somewhat more slowly. Although the absolute number of problems was not significantly affected by test presentation or anxiety, there was a tendency for high anxious subjects from both math classes to obtain about five more problems correct in the expectancy-reassurance than the standard condition on the word problem data.

The present study provides additional data supporting a motivational deficit theory rather than a cognitive or ability deficit theory of the performance of many children (Hill, 1972; S. B. Sarason et al., 1960; Zigler, Abelson, & Seitz, 1973; Zigler and Butterfield, 1968). Zigler, Abelson, and Seitz, 1973, for example, have shown that the IQ scores of disadvantaged preschool children were higher when IQ testing followed a "play" period with the examiner, compared to the IQ scores of those children who had not experienced this interaction with the examiner. Zigler and Butterfield (1968) devised an optimizing IQ testing procedure which involved the alternation of success and failure items and supportive comments from the examiner and were able to show that this procedure resulted in higher IQ scores for disadvantaged nursery school children than the standard IQ testing procedure.

With regard to motivational problems of children with a history of failure, there are a number of possibilities for further modification of performance strategies and the effects of approval/disapproval and success/failure motives in ways which may further enhance such children's performance in academic tasks. For example, the examiner could clearly indicate to the child that approval and disapproval are contingent upon the amount of effort expended by the child on the task, rather than on whether the outcome of such efforts are successful or not. Since effort at working on the task is more under the child's control than the actual outcome, this procedure provides the child with the strategy of "working harder" that will lead to success and approval and also should lessen the high anxious child's concern about disapproval (See Dweck, 1975a).

A second possibility would be to test the child two or possibly more times on the particular task. High anxious children have a long history of failure and negative feedback from teachers and parents in evaluative situations. It may take several sessions before these children fully accept the new expectations for performance or contingencies for adult approval and disapproval that the examiner provides in optimizing conditions. Initial wariness or mistrust of the evaluating adult, then, may be overcome fully only by the child's actually experiencing the consistent administration of optimizing contingencies, much as occurs with retarded children with similar avoidance tendencies (Zigler & Harter, 1969).

A third procedure that an adult examiner could use to enhance the performance of high anxious children would be to provide explicit rules to the child with regard to performance strategies that will lead to more successful performance in addition to simply providing information about the correctness of his response (See Dweck, 1975b; Hill, 1975). I. G. Sarason (1973), for example, has found with adult subjects that a model facilitates performance of high test anxious adults on difficult anagrams problems only when the model verbalizes to the subject principals underlying successful solutions to the task. With regard to the present findings, anxious children who are not doing well in school, such as those in the regular math class, may benefit from instructions in evaluative situations which tell the child to take more time in solving the problems and to strive for better accuracy. In contrast, anxious children doing well in school, such as those in the advanced math class in the present study, would presumably benefit more from instructions which encourage the child to proceed through a set of problems at a reasonably fast rate, while reminding the child that it is "all right to miss a few".

The results for the expectancy-reassurance condition in the present study provide evidence that high anxious children's achievement performance and estimation of their optimal functioning can be facilitated by changes in standard achievement testing procedures. The findings suggest that further development of optimizing procedures such as those discussed here is a promising direction for future research on motivation and achievement in children.

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Table 1

Mean Proportion Correct for Word Problems
as a Function of Test Presentation,
Anxiety and Math Class

| Math Class | Anxiety | Test Presentation | | | |
|---|---|---|---|---|---|
| | | Standard | Diagnostic | Expectancy-Reassurance | Normative |
| Advanced | Low | .84 | .77 | .85 | .78 |
| | Middle | .80 | .77 | .76 | .84 |
| | High | .79 | .81 | .69 | .76 |
| Regular | Low | .77 | .60 | .60 | .61 |
| | Middle | .67 | .54 | .56 | .55 |
| | High | .38 | .43 | .69 | .49 |

Table 2

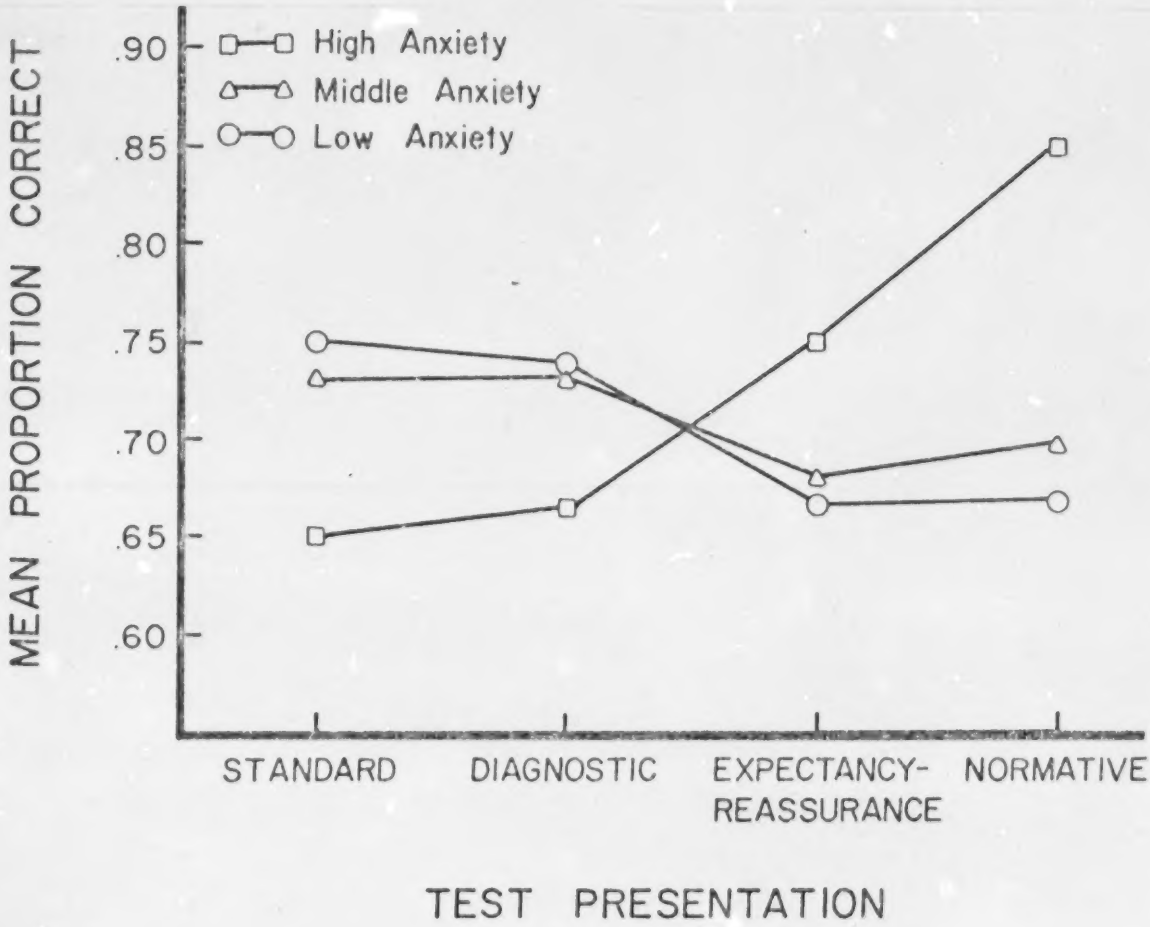
Mean Time Per Word Problem, in Seconds,
as a Function of Test Presentation,
Anxiety and Math Class

| Math Class | Anxiety | Test Presentation | | | |
|---|---|---|---|---|---|
| | | Standard | Diagnostic | Expectancy-Reassurance | Normative |
| Advanced | Low | 41.1 | 39.4 | 46.7 | 46.3 |
| | Middle | 41.8 | 37.2 | 41.6 | 50.5 |
| | High | 50.3 | 49.2 | 33.6 | 41.2 |
| Regular | Low | 57.6 | 48.0 | 42.6 | 46.4 |
| | Middle | 48.5 | 51.2 | 41.5 | 39.2 |
| | High | 41.4 | 45.4 | 48.6 | 91.7 |

## Figure Caption

Figure 1. Mean proportion correct on computation problems as a function of test presentation and anxiety. Different subjects determine each point.

Figure 1


MEAN PROPORTION CORRECT
.90
.85
.80
.75
.70
.65
.60
High Anxiety
Middle Anxiety
Low Anxiety
STANDARD
DIAGNOSTIC
EXPECTANCY-REASSURANCE
NORMATIVE
TEST PRESENTATION

# THE IMPACT OF SOCIAL CUES ON CHILDREN'S BEHAVIOR *

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* These papers are based on a symposium presented at the biennial meetings of the Society for Research in Child Development, Philadelphia, Pennsylvania, March 31, 1973. Requests for reprints should be addressed to Carol S. Dweck, Department of Psychology, University of Illinois, Champaign, Illinois 61820.

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# INDIVIDUAL DIFFERENCES IN CHILDREN'S RESPONSE TO ADULT PRESENCE AND EVALUATIVE REACTIONS[4]

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An adult can communicate his expectations for a child's behavior either through verbal feedback or through less explicit behavioral cues. The ways in which these social cues affect the child's behavior depends on his prior history of social interaction, his interpretation of the situation, and his current motivation. These cues can range from the presence of the adult to different kinds of explicit social evaluation.

This discussion will focus on theory and findings from three lines of research. One approach emphasizes the possibility of inhibitory as well as facilitating effects of an adult's presence. Such differential effects are likely to occur in situations in which the child may either perform or not, such as in a generalized imitation paradigm. A second focus concerns children's interpretation of the meaning of and response to non-reaction from an adult in more structured learning situations. A final interest is in the effects of social aspects of different kinds of overt feedback from an adult on children's learning and performance as a function of the child's motives to gain success and approval and to avoid failure and disapproval.

## Facilitating/Inhibitory Effects

It is assumed that adult presence will have differential effects depending on the child's social reinforcement history in similar situations and his expect-

tancies for current adult reactions for given behaviors. In this regard, my students and I have been interested in children's imitation of sex-inappropriate behavior. We've looked at the effects of the sex of the model on the probability that boys or girls will imitate such behaviors (Hill, 1971). We've become interested in the effects of an adult's presence versus his absence on such imitation. We assume that when a child has had a positive reinforcement history for behaving in a certain way, the adult's presence will facilitate performance, a form of social compliance. On the other hand, if the child has had a history of punishment, the adult's presence should inhibit or suppress behavior. Several studies (Peterson & Whitehurst, 1971; Steinman, 1971) have shown that imitation of appropriate behaviors is increased by an adult's presence or decreased if the adult leaves the situation. Studies by Meddock, Parsons, and Hill (1971), Redd and Wheeler (1974), and others show similar facilitating effects of an adult's presence in other performance and choice situations.

It is reasonable to assume that the child has been rewarded in the past for imitating or performing appropriately in similar situations. Thus the child may interpret these situations as ones in which the adult expects the child to imitate, perform at a high level, copy his preference, etc., and the adult's presence facilitates these behaviors. The adult's presence, however, could have quite different effects if in the past the child has been punished for engaging in a given behavior. As a result, the child may interpret the new situation as one in which the adult expects him to inhibit responding. For example, many boys have a strong history of punishment from adults for showing feminine behaviors or interacting with feminine objects, and the presence of an adult should deter rather than facilitate such responding compared to when the adult is absent.

There may be important individual differences, then, for both the strength and the direction of the effects of an adult's presence in situations such as those explored in the "generalized imitation" literature (see Hill, 1971; Meddock, Parsons, & Hill, 1971).

Informational/Motivational Properties of Non-Reaction

Let us turn now to research on effects of adult presence but non-reaction in structured problem-solving situations such as two-choice discrimination tasks. Here the child's task is not to decide whether to respond or not, such as in the "generalized imitation" situation, but rather to decide which response to choose as he attempts to learn the task. Much of the research in this area has focused on the effects of adult non-reaction (often termed "blank reaction") in combination with positive or negative overt feedback, that is, "right" or "wrong." Spence (1966) has shown with grade-school children that two-choice verbal list learning is better under Wrong-blank feedback (that is, where the adult tells the child when he is wrong but says nothing after correct choices) than under Right-blank feedback (where the adult tells the child when he is correct but says nothing when he is wrong.)

There are several interpretations of why children learn better under Wrong-blank than Right-blank feedback. Spence (1966) has obtained evidence that some children interpret blank as indicating they are correct unless they are instructed to the contrary. These children would use the blank feedback appropriately in the Wrong-blank combination by treating blank as right. Such children would have difficulty in the Right-blank combination, however, since they would treat both answers as being right. Another possibility is that being told you are wrong is more aversive than being told you are right is reinforcing (see Crandall,

Good, & Crandall, 1964). If this is the case, then children should learn more quickly in the Wrong-blank condition involving negative evaluation than the Right-blank condition. As Paris and Cairns (1972) and Redd (1974) have noted, 'Wrong' may also carry more information than 'Right.' Another factor that could be operating is that children who are apprehensive about negative evaluations, such as those who are highly test anxious, may be less willing to conclude that adult non-reaction means that they are wrong (as they must do in order to learn in the Right-blank condition) and more willing to conclude that it means that they are right (as in the Wrong-blank combination).

We have recently completed a study (Hill, Emmerich, Gelber, Lazar, & Schockedanz, 1974) seeking to clarify the information value of adult non-reaction in such two-choice learning tasks. Middle-grade-school-age children's interpretation of blank, or non-reaction from an adult as a function of its pairing with "right" or "wrong" overt feedback was studied in a non-evaluative, observational context. The child watched through a one-way mirror as an evaluating adult provided feedback to a tested adult who was performing at a two-choice discrimination learning task. The child used a response panel to indicate whether he thought blank reaction meant right, wrong, or he didn't know. Since the child was not learning the task himself, the adult's feedback had no bearing on the adequacy of the child's performance at the task and therefore the child's tendancies to avoid failure and disapproval should be operating minimally. The paradigm was thus designed to minimize motivational factors and optimize the chances of assessing the informational value of the blank reactions.

Results were clear-cut and quite strong. There was little evidence that children consistently interpret blank as meaning right in the absence of other

feedback. In contrast, there was overwhelming evidence (over 75% of responding), that children interpreted blank as meaning the opposite of the overt feedback it was paired with, quickly coming to mean wrong in a Right-blank condition, but quickly coming to mean right in a Wrong-blank condition. High-anxious children of both sexes showed these effects just as strongly as low-anxious children. Very importantly, blank came to mean wrong as quickly and strongly in the Right-blank combination as it came to mean right in the Wrong-blank condition.

The present results, then, indicate that middle-grade-school children (including high-anxious ones), are quite able and willing to interpret blank as meaning either right or wrong when paired with opposite overt feedback and do so quite quickly and consistently in an observational context in which their task performance is not being evaluated and they do not have to learn the complex task at hand. Such contrast effects may also occur in other observational-learning contexts--for example, when an adult is observing the performance of several children but providing feedback to only some of them. When a teacher or parent provides positive (or negative) feedback to one child but fails to respond to another, the latter child may interpret the adult's non-reaction as evaluative and meaning the opposite of the feedback provided the first child. All of these blank feedback effects should be strongest in situations in which the child cannot assess the adequacy of the performance being evaluated from previous experience or task outcome cues and hence has to rely on reactions of the adult or other situational cues. The present results in combination with earlier findings suggest that complex parameters determine the nature and generality of the effects of non-reaction to children in a variety of situations.

Social Aspects of Evaluation

Let us turn briefly to a third line of research concerning different kinds of social and non-social (or task-inherent) feedback available to children in problem solving situations. Here it is proposed that the effects of both an adult's presence and social evaluative cues differ widely as a function of the child's previous experiences in learning situations and resulting motivational dispositions. This work is related to a theory we have proposed elsewhere (Hill, 1972) about the motivational dispositions of children of varying levels of test anxiety. We have suggested that both the motives to obtain approval and success and the motives to avoid disapproval and failure increase as level of evaluation anxiety increases, but the increase is especially apparent for avoidance tendencies. Thus low-anxious children are relatively more concerned about succeeding and obtaining approval, whereas high-anxious children are more concerned about avoiding failure and disapproval. We have further suggested that effects of success and failure are enhanced if adult approval and disapproval accompany them. We seek success and fear failure because of the reactions of others.

Our present research examines systematic individual differences (with an emphasis on anxiety effects) on children's reactions to social aspects of adult evaluation, which can be quite complex. Consider first a situation involving non-social, or task-inherent, feedback only. We are developing a puzzle design task in which children sort WISC-type blocks into frame boards to complete designs they are told are all solvable. On each trial the child chooses which one of a set of five designs he wishes to make, ranging from a solid design involving block sides of all one color to a very complex pattern involving many

diagonal block sides. Two samples of grade-school children have shown very strong agreement in confirming five discrete levels of difficulty for the five designs in each set. The puzzle task has a clear criterion for success or failure on each problem, since the children can judge whether or not they complete a design. The situation can be arranged so that children perform alone and can be led to expect no subsequent adult evaluation--for example, by asking children to discard all designs and puzzle materials into big boxes before returning to regular school activities. Such a situation should involve minimal current social evaluation. At least three kinds of social evaluation can be added to this situation: 1) An adult can be present and able to monitor performance, so that current adult evaluation becomes possible. 2) An adult can explicitly promise to return later to evaluate later the adequacy of the child's efforts. 3) Social evaluation could be further enhanced by the promise of later social comparisons. Here the adequacy of the child's performance could be defined in terms of how well other children of the same age perform at the task. Consistent with Veroff's (1969) thinking and findings, we have suggested that as children become older, social comparison aspects of evaluation become the most powerful of all forms of feedback under consideration (Hill, 1972). We hypothesize that social evaluation of these kinds enhances the motivational effects of task-inherent success-failure feedback, especially for high-test-anxious children.

## Concluding Remarks

Our three lines of research are interrelated by several themes in common to the other papers presented here. There is an emphasis in all three areas on the child's desire to obtain approval and avoid disapproval from adults. The research shows some of the complex ways in which what is expected of the child is either

conveyed to the child in the testing situation or generated by the child on the basis of his past experience. In the sex-typing imitation research, children's expectancy for approval or disapproval is based on their previous experience with sex-typed objects. Adult non-reaction in the two-choice learning task can gain its evaluative meaning within the context of positive and negative reactions of the adult to other responses. And in the risk-taking paradigm, task-inherent feedback and social aspects of adult evaluation are believed to interact with children's approval and disapproval motives.

The present research also suggests complex ways in which adult presence but nonresponsiveness affects a variety of behaviors, and how the effects of such nonreaction interacts with concurrent approval or disapproval. Thus, in the imitation research, adult presence but non-reaction is seen to have an inhibitory or facilitating social control function in a situation in which the child may perform or not. On the other hand, in the highly structured learning task in which the child must choose a response on each trial, adult non-reaction appears to acquire both informational and motivational value as a function of the overt feedback it is paired with and evaluative aspects of the situation. And in the risk-taking research, the effects of possible success and failure for low and high test anxious children are hypothesized to be influenced by whether the child performs alone or with an adult present, and by whether and what kind of future adult evaluation is possible or promised.

Our three lines of research taken together seek to clarify what appear to be wide individual differences in the subtle but powerful influence exerted by both non-reaction from an observing adult and the evaluative aspects of social cues operative in a variety of interpersonal and achievement situations.

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[6] The discussion of current research on children's interpretation of implicit instructions in a modeling situation (i.e., generalization of imitation as a function of the model's verbalizations), included in the original version, has been omitted from the present paper.

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# Test Anxiety and Off-Task Behavior in Evaluative Situations

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Abstract

The relationship between performance and off-task behavior was examined as a function of children's anxiety level in a clearly evaluative situation. Forty-eight fourth- and fifth-grade boys and girls (assigned to low, middle, and high anxiety groups by their scores on the Test Anxiety Scale for Children) performed anagram tasks in the presence of an experimenter also working on anagrams. Frequency and direction of off-task glancing were used as measures of off-task behavior. As expected, both performance and off-task glancing were related to anxiety: high anxious children had the lowest performance scores and exhibited substantially more off-task glancing than low and middle anxious children. It was proposed that anxious children 's history of failure makes them more sensitive to and highly reliant on external feedback and evaluation and less likely to solve problems on their own.

# Test Anxiety and Off-Task Behavior in Evaluative Situations

It has been well established that test anxiety in children is an important determinant of performance on problem solving tasks in evaluative situations (Ruebush, 1963; Spielberger, 1972). Although high anxiety can be facilitating on simple tasks under certain conditions, it usually interferes with performance on tasks of moderate or greater difficulty, especially those involving reading or other verbal content (Hill, 1972; Sarason et al., 1960; Stevenson & Odom, 1965). In addition, high anxious children do less well in school than less anxious children as measured by achievement tests, school report card grades, grade repetition, and other indices of school learning (Hill & Sarason, 1966; Spielberger, 1972).

The theoretical basis of the extensive interfering effects of evaluation anxiety has not been clearly established. In the research literature, the interfering effects of anxiety have been attributed in part to the tendency of high anxious children to engage in task-inappropriate and task-irrelevant behavior in order to avoid immediate failure and disapproval (Hill, 1972). For instance, it has been proposed that high anxious children are inattentive to the task, in order to avoid evaluation; engage in attempts to interact socially with the evaluative agent, in order to gain approval on a basis other than performance; and approach problem solving with extreme caution, in order to avoid making mistakes (see Hill, 1972; Phillips et al., 1972; Ruebush, 1960). High anxious children also typically show perserverative, rigid

and stereotypic responding in problem-solving situations, lacking the flexibility to try different strategies in response to the demands of the task (Phillips et al., 1972).

It has been suggested, in addition, that anxious children's worry about the adequacy of their performance, both in its own right and how it compares to that of other children, may distract such children and prevent them from concentrating fully on the task at hand (Mandler, 1972; Mandler & Watson, 1966; Phillips et al., 1972; Wine, 1971). In effect, high anxious children are viewed as trying to cope at the same time with the task at hand and their worry about possible failure and disapproval.

Low anxious children, in contrast, are thought to respond to evaluation pressure by devoting greater attention to fulfilling the demands of the task. Their concern while performing is less with adult reaction than it is with succeeding at what they are doing (Cox, 1968). Anxiety level, then, seems to influence what children attend to in problem solving situations--and what children attend to in large part determines how they perform.

The purpose of the present study was to examine whether, and how, attention to--and especially attention away from--a problem-solving task varies with anxiety level. Frequency and direction of off-task glancing were used as measures of attention, since they had been shown to be sensitive indicants of off-task behavior in previous research in other areas (Ruble & Nakamura, 1972).

Following the Ruble and Nakamura (1972) paradigm, two anagram problems were developed, which subjects were to solve in the presence of

an experimenter who was also working on anagram problems. Three anxiety groups were formed, in contrast to the usual procedure of forming groups of extremely low and extremely high anxious children, in order to include the full range of anxiety among subjects available for testing. Accordingly, the nature and extent of off-task glancing was examined in a clearly evaluative situation at three levels of anxiety.

It was hypothesized that high anxious children would perform more poorly on anagram tasks and glance away from their tasks at a higher rate than low and middle anxious children. Specifically, in view of anxious children's reliance on adults for assistance and evaluation of their performance (Hill, 1972), it was expected that they would direct more glances toward the experimenter and the experimenter's task than either low or middle anxious children. Moreover, in view of their greater tendency to avoid evaluative situations entirely, it was also expected that high anxious children would have a greater number of off-task glances directed away from the experimenter and his task, elsewhere around the room. In line with previous research relating anxiety to performance, it was expected that middle anxious children would perform and exhibit glancing patterns intermediate to those of low and high anxious children (Hill & Sarason, 1966).

## Method

### Subjects

The subjects were fourth- and fifth-grade children drawn from two middle-class elementary schools in Champaign-Urbana, Illinois: fourth-grade children from one and fifth-grade children from the other school.

It was not possible to test at both grade levels in either school due to other ongoing projects and school activities.

All fourth-graders available for testing in the first school were given the Test Anxiety Scale for Children (TASC) and the Lie Scale for Children (LSC) (Sarason et al., 1960) six months prior to testing. In the second school, whose cooperation was obtained later, these self-report scales were administered to all fifth-grade children available for testing three weeks prior to the beginning of the experiment.

Written permission for participation in the study was solicited from the parents of 136 children, and permission was obtained for 76 (56%) of these children. All 76 children were tested.

As in previous research, a moderate negative correlation between TASC and LSC scores was found for boys and girls in the two grades ($r$ between -.43 and -.56), indicating that the population was representative of those studied earlier (Hill, 1972). Thirteen children were excluded from the sample on the basis of high LSC scores (seven or higher on the 11-point scale), because of the questionable validity of the typically low TASC scores of such children (Hill, 1972); highly defensive children, including those who report little anxiety, have been found to show at least moderately strong anxiety dynamics, especially boys (Hill & Sarason, 1966). Four additional children were dropped from the study due to videotape recorder failure and procedural interruptions. Of the remaining 59 children (13 boys and 15 girls in grade four and 12 boys and 19 girls in grade five), an equal number of boys and girls from each grade at each of low, middle, and high anxiety

levels were chosen randomly to complete a 2 (Grade) x 2 (Sex) x 3 (Anxiety Level) x 2 (Tasks) mixed factorial design with 48 subjects. The mean TASC scores for the low, middle, and high anxious subgroups were 3.69, 9.81, and 18.91, respectively.

Experimental Task

The experimental task consisted of two anagram boards with a set of 10 letters each: one with the letters of the word generation, the other with the letters of the word inoperable. The first of these words was used with same-age children in a study by Stevenson and Odom (1965), who found that children's performance on the task was negatively related to anxiety; the second one was selected for its potential equivalence in yield of commonly used words.

Apparatus and Materials

All subjects were tested in a mobile laboratory trailer equipped with a one-way mirror between experimental and observation rooms. The experimental sessions were videotaped through the one-way mirror.

The letters of the anagrams were capitals printed on 2.54 cm white masonite squares. These squares were placed on corresponding printed letters in 10 gray 2.54 cm squares across the top of a white 25.4 x 48.1 cm anagram board. These letters spelled out the respective words. The lower half of the anagram boards contained a gray work area for forming words.

In addition to the two anagram boards constituting the experimental task for the subjects, two further boards were used by the experimenter: a demonstration board with the 10 letters of the word buttercups and a board with the 10 letters of the word theatrical.

Procedure

The experimenter, a male student in his early twenties naive to the purpose of the research, escorted each subject individually from his classroom to the mobile laboratory. In the experimental room, the subject was seated at a table directly across from the experimenter. The experimenter demonstrated with the buttercups board how to form a word by moving letters from the top of the board to the work area, record the word on the notepad, and return the letters to their places before forming the next word. The experimenter then gave the subject his first set of letters (the word generation) with instructions to form as many words as possible in five minutes. The experimenter turned away slightly to his left to work with the second set of letters (the word inoperable), placed on that side, giving the subject a three-quarter profile view of his face and a full view of his anagram board. After five minutes, the experimenter presented the subject with his second set of letters, (the word inoperable) and a fresh notepad with the same instructions, and then proceeded to work on the theatrical anagram board.

On the inoperable board he was using during Task 1, the experimenter generated only words that could not be duplicated by the subject in the same session with his generation letters, so that the subject could not copy from the experimenter during Task 1. The experimenter's words were taken from a list of words presumed to fall outside fourth- and fifth-graders' everyday vocabulary; words like elan, lair, elope, etc. While not of primary concern, it was of interest whether subjects would copy the experimenter's words when they received the inoperable

letters as Task 2. The fact that only 5% of the words children generated from inoperable were those the experimenter made during the first task suggests that word outcomes on the experimenter's board probably were not closely monitored by the subjects. Since the experimenter worked with different sets of letters during the same session; and since subjects were not informed that they would be using the experimenter's Task 1 letters during Task 2, repeated glancing at the experimenter's words was not a strategy that would facilitate performance. In the same vein, while an initial glance toward the experimenter's task might provide general procedural information about the task and reflect task-related behavior, repeated glancing would provide little or no additional task information. Thus, whether subjects were glancing at the experimenter's board to gain specific word or general task cues, repeated glancing at the experimenter's task would constitute task-inefficient and dependent behavior.

At the beginning of each five-minute session, the experimenter started a stopwatch. He then began to form words at a moderate rate of one word every 15 to 20 seconds, left them in the work area of his anagram board for about 15 to 20 seconds, returned the letters to their places, and waited 5 to 10 seconds before beginning to form the next word. In order to emphasize the evaluative nature of the task, the experimenter looked back at the stopwatch and subsequently toward the subject's anagram board on the average of once a minute in both sessions.

After completion of the second task, the experimenter looked over the word lists and commented favorably on each child's production, so

that all subjects left the experimental situation with a positive assessment of their performance.

Five measures were taken: (1) the number of words formed, (2) glances directed at the experimenter's task, (3) glances directed at the experimenter, (4) other off-task or nondirected glances, and (5) questions or comments addressed to the experimenter.

## Results

A 2 (Grade) x 2 (Sex) x 3 (Anxiety Level) mixed factorial analysis of variance with Tasks as the repeated measure was performed on anagram scores, total number of off-task glances, the three subcategories of glancing, and on comments and questions directed at the experimenter. In addition, in order to examine changes over time within task, each task was analyzed separately, with Minutes as a repeated measure.

### Performance Scores

The overall analysis yielded significant effects for anxiety level ($F$ [2,36] = 6.12, $p < .01$) and grade ($F$ [1,36] = 7.13, $p < .05$). The middle anxious subjects achieved the best performance scores ($\bar{X}$ = 16.3), low anxious subjects were next ($\bar{X}$ = 13.8), and high anxious subjects showed the poorest performance ($\bar{X}$ = 11.5). Fourth-graders formed fewer words ($\bar{X}$ = 12.3) than fifth-graders ($\bar{X}$ = 15.4)

The minute-by-minute analyses showed highly significant differences over time on both Task 1 ($F$ [4,144] = 16.29, $p < .001$) and Task 2 ($F$ [4,144] = 18.24, $p < .001$). On both tasks, most of the words were generated during the first minute ($\bar{X}$ = 4.1 and 4.0 for Tasks 1 and 2, respectively). Over the remaining four minutes, the rate of word

formation per minute declined ($\bar{X}$ = 2.6 and 2.3 for Tasks 1 and 2, respectively) (see Figure 1).

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Insert Figure 1 about here

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As expected, then, performance of high anxious children was below that of both low and middle anxious children. Contrary to expectation, however, the performance of middle anxious children actually was higher than that of low anxious children.

Off-Task Glances

The overall analysis of off-task glances summed over categories yielded significant effects for anxiety ($F$ [2,36] = 3.55, $p < .05$), grade ($F$ [1,36] = 5.13, $p < .05$) and tasks ($F$ [1,36] = 4.04, $p < .05$). High anxious children glanced away from their task much more frequently ($\bar{X}$ = 8.59) than either middle anxious ($\bar{X}$ = 5.41) or low anxious children ($\bar{X}$ = 5.28) (see Figure 2). Fourth-graders glanced away from their tasks more frequently ($\bar{X}$ = 7.73) than fifth-graders ($\bar{X}$ = 5.13).

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Insert figure 2 about here

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Children glanced away more on Task 1 ($\bar{X}$ = 7.08) than on Task 2 ($\bar{X}$ = 5.77).

The minute-by-minute analyses yielded highly significant differences over time on both Task 1 ($F$ [4,144] = 7.47, $p < .001$) and Task 2 ($F$ [4,144] = 5.02, $p < .001$). On both tasks, the off-task glancing

rate was lowest during the first minute ($\bar{X}$ = .56 and .42, respectively), when most of the words were generated. Over the remaining four minutes this rate tripled ($\bar{X}$ = 1.63 and 1.34 on Tasks 1 and 2, respectively, across the last four minutes) (see Figure 1).

As expected, then, high anxious children, who had the lowest performance scores, glanced away from their task more often than either middle or high anxious children. Furthermore, word production dropped and the overall glancing rate increased over time on both tasks.

Glances at the Experimenter's Task

An overall analysis of glances directed at the experimenter's task yielded a significant anxiety effect ($F$ [2,36] = 4.53, $p < .05$) in the expected direction: high anxious subjects looked at the experimenter's task at a higher rate ($\bar{X}$ = 3.69) than either low anxious ($\bar{X}$ - 2.16) or middle anxious ($\bar{X}$ = 2.00) subjects (see Figure 2).

The minute-by-minute analyses showed significant differences over time on both Task 1 ($F$ [4,144] = 4.08, $p < .01$) and Task 2 ($F$ [4,144] = 3.14, $p < .05$). Glancing increased over minutes on both Tasks 1 and 2.

As expected, then, high anxious children, who generated words at a rate consistently lower than low anxious and especially middle anxious children, glanced at the experimenter's task more frequently than low anxious or middle anxious children. Also, such glancing increased over minutes, as word production went down.

Glances at the Experimenter

No significant anxiety level differences were found in the overall analysis of glances directed at the experimenter (see Figure 2). The

only significant main effect obtained was for tasks ($F$ [1,36] = 6.62, $p < .05$). More glances were directed at the experimenter during Task 1 ($\bar{X}$ = 2.79) than during Task 2 ($\bar{X}$ = 2.08).

The minute-by-minute analyses showed significant differences over time on both Task 1 ($F$ [4,144] = 2.84, $p < .05$) and Task 2 ($F$, [4,144] = 3.52, $p < .01$). Glances at the experimenter increased over minutes, as word production went down.

Other or nondirected Glances

The overall analysis of nondirected glances--glances directed neither at the experimenter's task nor at the experimenter--revealed a significant anxiety effect ($F$ [2,36] = 3.91, $p < .05$). High anxious children exhibited nondirected glancing at a substantially higher rate ($\bar{X}$ = 2.31) than middle anxious ($\bar{X}$ = .94) or low anxious subjects ($\bar{X}$ = .88) (see figure 2).

The minute-by-minute analyses yielded a significant minutes effect only for Task 1 ($F$ [4,144] = 6.06, $p < .001$), but not for Task 2 ($F$ [4,144] = 2.13, $p < .01$), although the mean number of nondirected glances increased over minutes on both tasks.

Questions or Comments Addressed to the Experimenter

The overall analysis of questions or comments directed at the experimenter yielded a significant sex effect ($F$ [1,36] = 5.26, $p < .05$): boys directed more questions and comments to the experimenter than girls ($\bar{X}$ = 1.00 and .31, respectively). There was also a significant anxiety by task interaction ($F$ [2,36] = 4.01, $p < .05$): on Task 1 both low anxious ($\bar{X}$ = 1.19) and middle anxious ($\bar{X}$ = .94) children directed more

comments at the experimenter than high anxious children ($\bar{X}$ = .13), whereas on Task 2 only middle anxious children ($\bar{X}$ = 1.00) directed more comments at the experimenter ($\bar{X}$ = .44 and .25 for low and high anxious subjects, respectively).

The minute-by-minute analyses revealed no significant differences over time on Tasks 1 and 2.

## Discussion

The major finding in the present study was that high anxious children, as expected, had the lowest performance scores and exhibited substantially more off-task glancing than low and middle anxious children. Middle anxious children, however, outperformed low anxious children on the anagram tasks, although both middle and low anxious children showed similar glancing patterns. These findings were general to the sample and did not interact with the child's sex or with his age and school.

As expected, overall performance and off-task glancing measures were negatively related, and this negative relation between performance and off-task behavior was further substantiated by minute-by-minute analyses of changes across the sessions. It is noteworthy that both the rate of word formation and the rate of off-task glancing covaried in relation to anxiety. Low and middle anxious children showed less off-task glancing and did better at the task than high anxious children. The high anxious children's significantly higher rate of off-task glancing, both at the experimenter's task and especially elsewhere in the room, offers support for the hypothesis that high anxious children, who

typically perform poorly in evaluative situations (Hill, 1972; Stevenson & Odom, 1965), tend to avoid performing at tasks by looking completely away from the task. Such a marked tendency to exhibit off-task glancing may account in good part for anxious children's lower performance. In future research with tasks involving continual feedback about task performance, it would be of interest to study possible reciprocal effects of task success and off-task glancing as children progress through a task as well as the overall relationship between performance and glancing as studied here.

The high anxious children's significantly higher rate of glancing at the experimenter's task also suggest that these children may have been seeking clues toward solution of their anagram rather than trying to solve the problem on their own. This significant tendency of high anxious children to glance more at the experimenter's task than low and middle anxious children showed little change across the five minutes of the tasks. Since no specific word information was to be gleaned, however, this tendency to continue glancing at the experimenter's task would suggest that high anxious children were either unable or unwilling to abandon their external orientation; or, further, that they lacked the flexibility that would permit them to select and/or change to an appropriate strategy based on task-inherent feedback and make a deliberate effort to generate words on their own (see Hill, 1972).

Although low, middle, and high anxious children did not differ significantly in the rate at which they glanced at the experimenter, verbalizations that accompanied glances suggest that they may have been

doing so for different reasons. Verbalization data, taken from the videotapes, revealed that low and middle anxious children--boys, in particular--were asking questions while glancing at the experimenter and that the questions raised by these children were almost exclusively task-related (57 of the total of 63 questions raised were asked by 19 low and middle anxious children; and 55 of those 57 questions were task-related). In contrast, almost no questions were asked by high anxious children (only 6 of the 63 questions raised were asked by 4 high anxious children). The glances of the high anxious children towards the experimenter may reflect their concern over evaluation of their performance, and their reluctance to ask questions may have been due to their strong motive to avoid possible negative reactions from adults.

Turnure and Zigler (1964) have observed off-task glancing such as shown by high anxious children in the present study, usually labeled distractibility, in both retarded and normal children. They proposed that it represents an outer-directed problem-solving strategy that is adopted by children who have a history of failure (the kind of history high anxious children are assumed to have) and who have learned to depend on external cues from their parents and other adults instead of relying on their own resources. Research on family interaction patterns associated with high and low levels of distractibility in fourth-grade children (bee, 1964) and on family interaction patterns associated with high and low levels of anxiety in fourth- and fifth-grade children (Hermans et al., 1972), does in fact, support the hypothesis that strong dependence on adults and on outer-directed problem-solving

strategy may be learned in the family in early childhood. Bee (1964) found that parents of highly distractible children tended to extend help so specific and directive that they practically took over for their children in problem-solving situations, while parents of nondistractible children were more apt to offer strategic information that permitted their children to proceed on their own. According to Hermans et al. (1972), parents of high anxious children tended to ignore their children's expressions of insecurity, withholding both support and constructive help in problem-solving situations. Instead of helping their children to establish task-relevant responses, when they were having difficulties in solving problems, they tended to react with negative affect. Hill (1972) has noted that such a negative history of interaction between parent and child causes high anxious children to be more concerned with avoiding disapproval and failure than with obtaining approval and success, tendencies which may underlie many of the effects of high anxiety. Low anxious children's parents, on the other hand, tended to provide their children with both emotional support and problem-solving strategies when they showed signs of insecurity (Hermans et al., 1972), which may result in greater orientation towards success and approval in such children.

Parents of highly distractible and high anxious children, then, although differing in the specific nature of their reactions, may both be teaching their children to respond to problem-solving situations with task-irrelevant or task-inappropriate behavior and to become overly reliant on the reaction of others in evaluative situations, at the

expense of performance. Parents of nondistractible and low anxious children may be teaching their children to become task-oriented and self-reliant in their problem solving.

The results of the present study indicated that high anxious and less anxious children indeed do differ in the way they attend to a task under evaluation conditions. Taken together with the parent-child interaction studies, these findings suggest that anxious children's performance can be improved by increasing their on-task orientation through task-inherent direction (e.g., programmed instruction) and task-relevant feedback. Test anxiety research with adults (e.g., I. G. Sarason, 1972) suggests that modeling of problem solving with the verbalization of strategy facilitates subsequent performance of high anxious individuals. To help anxious children in the classroom, then, teachers could model problem-solving strategies, especially when introducing new material, and formulate rules to help children attend to the relevant parameters of the task. Finally, teachers could encourage anxious children to evaluate their own performance at the task and also provide them with strategies for assessing task-related feedback rather than to be overly reliant on external evaluation.

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## Figure Captions

Figure 1. Mean number of words produced and mean number of total off-task glances for all children over minutes on Tasks 1 and 2.

Figure 2. Mean number of total off-task glances, glances directed at the experimenter's task, glances directed at the experimenter, and nondirected glances for children at each level of low, middle, and high anxiety.

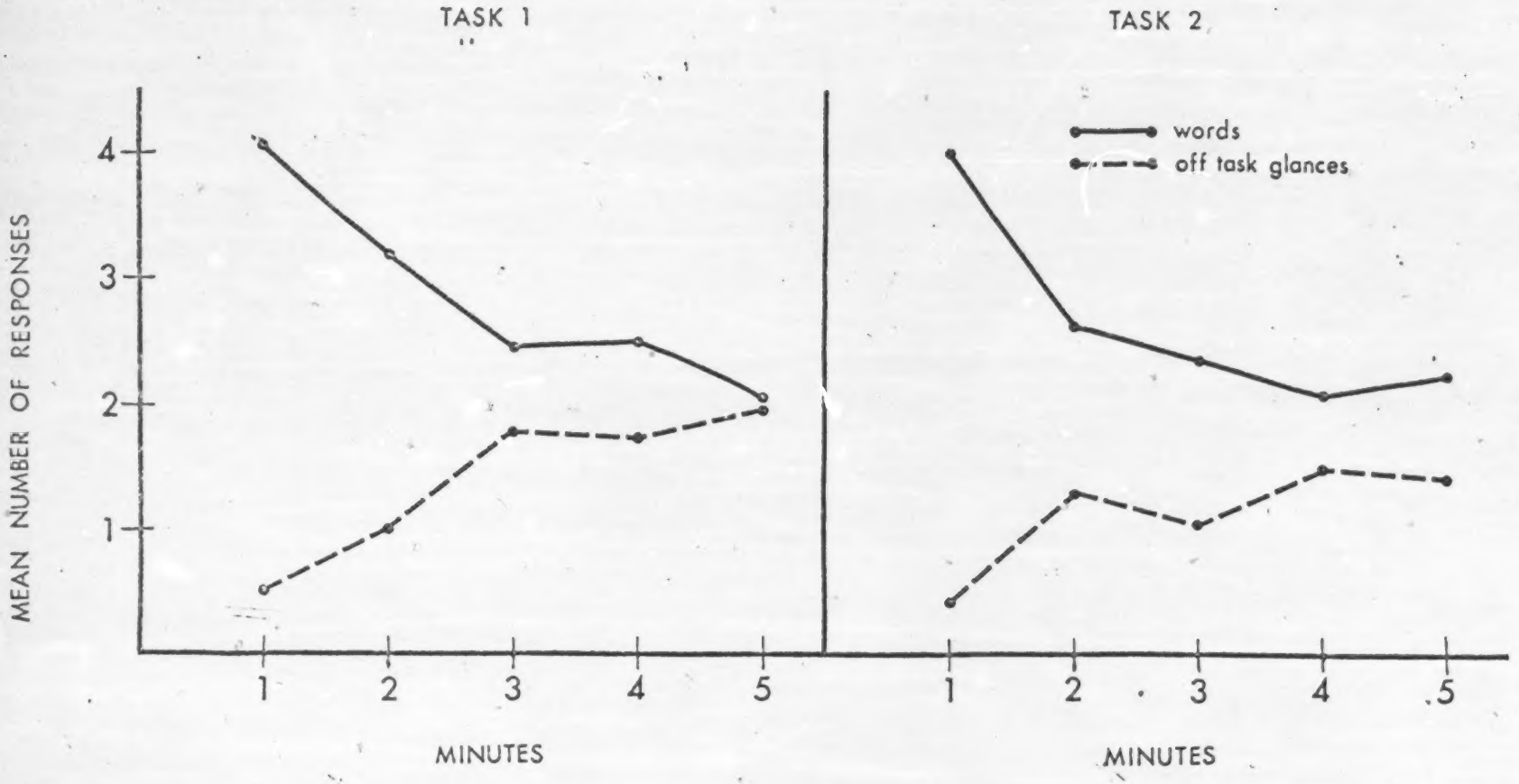
TASK 1
TASK 2
words
off task glances
MEAN NUMBER OF RESPONSES
4
3
2
1
1
2
3
4
5
MINUTES
MINUTES

Figure 1

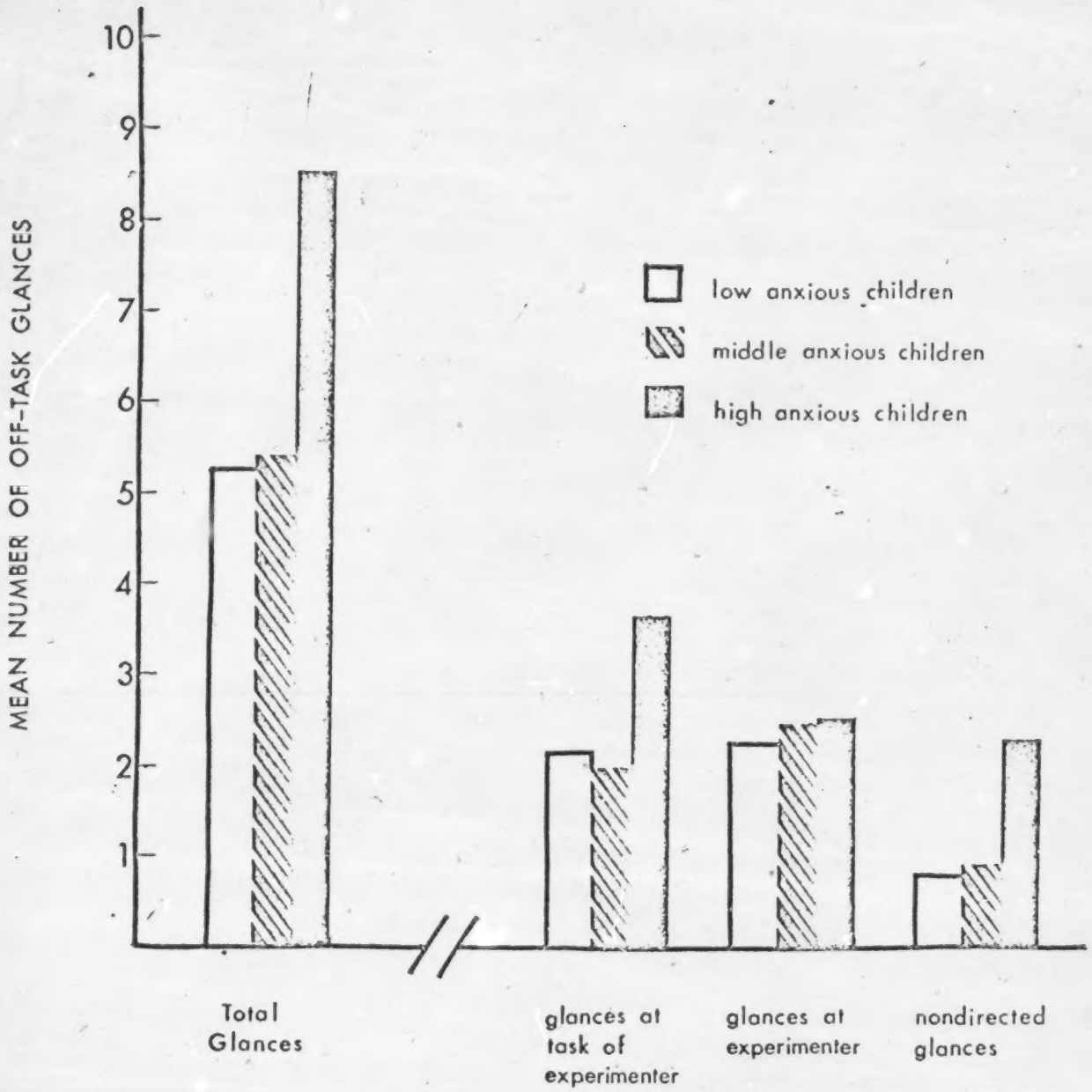
MEAN NUMBER OF OFF-TASK GLANCES
10
9
8
7
6
5
4
3
2
1
low anxious children
middle anxious children
high anxious children
Total Glances
glances at task of experimenter
glances at experimenter
nondirected glances

Figure 2

1975 SRCD paper

# Developmental Changes and Individual Differences in Children's Reactions to Negative Evaluations[1]

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A paper presented as part of a symposium on:

Negative Evaluation and Feedback: Impact and Implications for the Agent and Recipient

Biennial meeting of the Society for Research in Child Development

Denver, Colorado, April 11, 1975

It seems clear that a child's ability to make effective use of negative evaluations from adults becomes an increasingly important determinant of his academic and social development. Today I would like to examine several developmental changes either in children's interpretation of, or reactions to evaluative feedback from adults. Then I will relate these developmental changes to individual differences in children's sensitivity and reactions to negative evaluation.

Let us turn first to research suggesting developmental changes in children's interpretation of different kinds of adult feedback. Ginny Crandall (1963), for example, found that junior high school age children reacted quite differently to adult non-reaction depending upon what overt feedback preceded it. If nonreac-

tion followed positive reactions, children responded as if the nonreaction was a negative evaluation. In contrast, nonreaction following negative feedback was responded to as if the nonreaction was positive in meaning. Thus a contrast effect was present: Nonreaction was interpreted as meaning the opposite of whichever overt feedback it followed.

Dale Montanelli and I (Montanelli & Hill, 1969) found quite different results for younger children in the late elementary school years. For these younger children, the effects of preceding positive or negative feedback were not reversed during subsequent nonreaction from an adult. Nonreaction seemed to have little informational value. On the other hand, if the adult switched from either positive or negative feedback to opposite overt feedback, for example, from positive to negative, then the children responded very strongly to the second kind of feedback they received. I might mention as an aside that, consistent with the research just summarized by Bill Redd, children responded initially more strongly to negative than positive feedback and also more strongly to the negative feedback when it came second.

These studies taken together suggest that within the context of what feedback came previously, young children appear to interpret only overt negative feedback from adults as indicating negative evaluation, while older children may respond to neutral adult reactions as being negative in nature depending on what previous feedback has occurred. We would speculate further that for still older children and adults, it is possible that a shift to a mild form of the same overt feedback or to less frequent overt feedback of the same kind may be reacted to as having opposite meaning to the initial overt feedback. Thus an adult receiving rather frequent positive evaluation and later somewhat less frequent positive feedback from the same individual may interpret the

less frequent but still positive reactions as indicating a negative assessment. Changes in facial expression and vocal cues may also cause the person being evaluated to interpret feedback as changing in meaning. For example, criticism no longer given in a harsh voice or with a frown may be interpreted as being a change toward a more positive assessment from the teacher, parent, or other evaluating adult.

So far we have been discussing children's and adults' reactions to changes in an adult's evaluative reactions. Let us turn now to the absolute nature of the feedback being given. A second hypothesized developmental change is that as children become older, feedback they interpret as being negative is objectively given in increasingly positive manner. Young children may respond only to overt criticism as meaning negative evaluation. Older children may interpret the adult's failure to respond as indicating a negative assessment. And for adults, mild positive reactions may be interpreted and function as negative evaluation, the familiar 'damning with faint praise.' Or perhaps in this era of grade-inflation and letter-of-recommendation inflation, we should say 'damning with considerable praise.'

Why might this be? Why would young children only respond to overt criticism as indicating negative evaluation while older children and adults interpret neutral or even somewhat positive feedback as being negative evaluation? Perhaps the answer lies in how adults provide feedback to children of different ages, so that in all cases the children are simply responding to feedback in terms of its functional use by adults. Adults often may express their positive and negative reactions to children freely and directly. For the young child and his parents, a spade is a spade whether the child is "being good" or misbehaving. But adults may find it increasingly difficult to provide direct overt

feedback as children become older and reach adulthood, especially negative feedback in highly evaluative interpersonal situations. Such negative evaluation may be as aversive for the adult trying to give it as for the older child or adult receiving it, or perhaps it is more accurate to say trying not to receive it. Moreover, young children typically do not question the legitimacy or right of the parent or other adults to provide negative evaluations. Older children and adults, in contrast, may challenge either the appropriateness or the validity of negative feedback from an adult.

We are suggesting, then, that adults may provide negative feedback in different ways to children of different ages, being more overt and direct with young children and more indirect and even positive with older children. The same reaction from an adult may then be correctly interpreted by the recipient as meaning different things at different ages. Children thus would make increasingly subtle discriminations of adult evaluative reactions at older ages. Consider nonreaction: To a young child nonreaction may mean nothing. To an older child, nonreaction may be neutral in meaning, and to adults, nonreaction may typically be interpreted as being negative in nature. The next time a colleague gives you a paper to react to, give him a kind of non-committal neutral reaction and see if he doesn't respond as if you don't think much of his paper or starts probing to learn what you didn't like about it.

So far we have discussed developmental changes in children's interpretation of different kinds of adult feedback or changes in feedback. A third developmental change relevant to the theme of this paper concerns how children at different ages respond to negative feedback in terms of problem solving strategies. Sally Allen (1966) and others have found that criticism disrupts younger elementary school age children's performance and causes them to leave

a task quickly. In direct contrast, for older elementary school age children, criticism facilitates the child's trying new solutions and strategies for performing at a task and results in greater persistence than does positive feedback (Allen, 1966). Younger children thus respond to negative (and positive) feedback as would be expected from a straight forward reinforcement model, performing better and persisting longer under praise but doing less well and leaving sooner under criticism. Older children, however, process the same feedback quite differently. This may be due in part to the contingencies used by adults in providing negative feedback to children. For young children, adults may more often than not use disapproval when they wish a child to terminate a behavior, e.g. to stop hitting another child. As children become older, negative feedback from adults may often be used in an attempt to modify the child's behavior, especially in achievement and problem solving situations, in which standards of excellent are nearly always involved. Thus negative adult evaluation may often signal young children to stop what they are doing but older children to change their behavior. As Sally Allen notes, older children appear to change their problem solving activities in response to criticism in an apparent effort to find a more correct solution to gain approval. Younger children do not appear to relate criticism to their performance strategies or change them. Within Bill Redd's framework, one might expect a criticizing adult to have strong negative valence for younger children, since aversive feedback is being experienced but does not lead to positive gains in performance; for older children, a criticizing adult might have either a positive or negative valence depending on the usefulness of the criticism in helping the child improve performance on a meaningful task.

We are suggesting, then, that older children differ from younger children both in what is construed as negative evaluation and in their inclination or ability to use that negative feedback to effectively modify performance strategies to achieve greater subsequent success. Let us turn now to an individual difference variable, children's level of evaluation anxiety, which appears to play a major role in children's development of more mature reactions to negative feedback and to their response to some of the factors discussed by Bill Redd and Carol Dweck. The hypotheses discussed here are related to a theory we have proposed elsewhere (Hill, 1972) about the motivational dispositions of children of varying levels of evaluation anxiety. Briefly, we have suggested that both the motives to obtain approval and success and the motives to avoid disapproval and failure increase as level of evaluation anxiety increases, but the increase is especially apparent for the avoidance tendencies. Thus low anxious children are relatively more concerned about succeeding and obtaining approval whereas high anxious children are relatively more motivated to avoid failure and criticism, although both approach and avoidance tendencies are high for these latter children. Children with strong evaluation anxiety, then, may be overly responsive to evaluative reactions of adults, and especially to negative feedback.

Anxious children's dominant motives to avoid disapproval and failure leads them to respond to criticism and disapproval in much the same way as younger children as we discussed earlier. Under criticism, anxious children may leave evaluative situations quickly, perform less efficiently and more slowly and cautiously, and accept the negative feedback without changing performance strategies at a task to obtain positive outcomes (Hill, 1972), much like Allen (1966) found for kindergarten children. Low anxious children, in contrast, show

the tendencies Allen found for older grade school children --- persistence under negative evaluation and flexibility in changing problem solving strategies in order to arrive at correct solutions.

On the basis of our theoretical analysis, anxious children should also respond more to the general affect entailed in negative evaluation and be less able to process and use the information communicated by the feedback. Anxious children should then develop a strong negative valence toward adults providing negative feedback. Less anxious children, because of their ability to process the information involved in negative evaluation and use that information to enhance their performance to eventually gain positive outcomes, should develop a relatively more positive valence toward the adult providing criticism.

Because of their strong motivation to avoid disapproval and failure, it is also predicted that children with strong evaluation anxiety will be less likely to interpret ambiguous feedback as being negative in meaning. For example, junior high school age high anxious children may be less likely to interpret nonreaction following positive feedback as being negative, as Ginny Crandall found in general for children of this age. Such a tendency would help the anxious child avoid the immediate aversive experience of failure but of course only at the expense of losing the informational value of indirect negative feedback which would help the child improve his subsequent performance. Anxious children would then lag developmentally behind their low anxious counterparts in their willingness or ability to correctly interpret nonreaction, mild positive reactions, and other relatively subtle forms of negative evaluation given by adults to older children and other adults (See Hill, Emmerich, Gelber, Lazar, & Schickedanz, 1974). High anxious children may respond only to overt negative feedback much like younger children. Indeed, hesitancy of anxious children to interpret correctly negative evaluations communicated in

increasingly subtle ways as the child becomes older may account in part for his increasingly poor classroom learning and achievement, again since the anxious child does not recognize or use the informational value of the feedback in his learning activities.

The anxious child's strong motives to avoid disapproval and failure should also result in several additional preferences related to the work of Bill Redd and Carol Dweck discussed earlier in this symposium. First, the anxious child should prefer a situation in which the adult feedback is non-contingent on his performance rather than contingent, since the former should be less likely to signal evaluation and possible failure and further disapproval from the adult. Second, the child with a high level of evaluation anxiety should prefer tasks involving luck rather than ability (See Dweck, 1975), again to avoid negative assessment of his performance and possible adult disapproval. Finally, the anxious child's strong general responsivity to adult reactions will cause the child to avoid or perform poorly in situations involving simply the potential for adult feedback, such as when an adult is present and monitoring performance but not responding, or absent but may return later to evaluate the child's work on the basis of a performance outcome or record.

What can be done to help high anxious children deal effectively with adult feedback? Our analysis suggests several ways of changing evaluation practices which could promote younger and anxious children's effective use of negative feedback to improve their performance. Such changes would involve increasing both the child's ability to process the information contained in negative feedback and his positive motivation in evaluative situations. For example, Bill Redd's finding that a combination of positive and negative feedback produces a greater valence for the evaluating adult than just negative feedback should

hold especially for older anxious children as well as for younger children in general. A mixture of success and failure or approval and disapproval, perhaps with a predominance of positive outcomes and feedback, should especially help anxious children by bringing into play their strong motives to attain success and gain approval, as well as the even stronger motives to avoid failure and disapproval which negative evaluation alone would trigger. Carol Dweck's suggestion that adults use explicit, unambiguous feedback and provide an explanation of the basis of a child's failure and strategies for enhancing successful performance should be particularly helpful for young children and older anxious children since these youngsters are less likely to interpret criticism appropriately and use that information in their subsequent problem solving efforts. The theory and research suggested in our symposium, then, are suggesting ways in which adults can provide negative as well as positive feedback to children to optimize different children's learning and performance and to enhance the positive valence of learning and other evaluative situations.

Footnote

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# NEGATIVE EVALUATION AND FEEDBACK: IMPACT AND IMPLICATIONS FOR THE AGENT AND RECIPIENT

A symposium presented at the biennial meeting of the Society for Research in Child Development, Denver, Colorado, April 11, 1975

## PARTICIPANTS

Chair: Carol S. Dweck, University of Illinois, Urbana-Champaign

SIDE EFFECTS OF THE USE OF NEGATIVE FEEDBACK
William H. Redd, University of Illinois, Urbana-Champaign

SEX DIFFERENCES IN THE MEANING OF NEGATIVE EVALUATION IN ACHIEVEMENT SITUATIONS: DETERMINANTS AND CONSEQUENCES
Carol S. Dweck, University of Illinois, Urbana-Champaign

DEVELOPMENTAL CHANGES AND INDIVIDUAL DIFFERENCES IN CHILDREN'S REACTIONS TO NEGATIVE EVALUATION
Kennedy T. Hill, University of Illinois, Urbana-Champaign

Discussants:
Robert Cairns, University of North Carolina
Harold W. Stevenson, University of Michigan